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1985 SAE Handbook

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The 1985 SAE Handbook is comprised of four separate volumes, each available separately. The titles of the volumes are:

Volume 1–Materials
Volume 2–Parts and Components
Volume 3–Engines, Fuels, Lubricants, Emissions, and Noise
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A separate Index Volume is provided with each volume or set. This index includes the Tables of Contents for the four Handbook volumes along with a Numerical Index of Standards, Recommended Practices, and Information Reports; a complete Subject Index; and Related Technical Reports not included in the Handbook volumes.

Other volumes of the 1985 SAE Handbook, or additional copies of the separate Index Volume, may be ordered by contacting Customer Service, SAE, 400 Commonwealth Drive, Warrendale, PA, 15096 (412) 776-4970.

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All new and revised reports contain SI (metric) equivalents of all dimensions. The SAE Metric Advisory Committee appreciates receiving any comment and/or suggestions regarding the conversions.

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NUMERICAL INDEX FOR SAE STANDARDS, RECOMMENDED PRACTICES, AND INFORMATION REPORTS

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Effective with the 1981 SAE Handbook, revisions of reports are now indicated by the month and year of revision, for example, J1159 AUG79. This new system will be phased in over a five year period. A lower case "a," "b," etc., appended to the report designation number indicates successive revisions of older reports.

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NOTE: Page numbers shown include the volume number in bold followed by the section number and page number within that section.

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CANCELLED STANDARDS, RECOMMENDED PRACTICES, AND INFORMATION REPORTS

SAE reports listed below in "J number" order are those reports which have been cancelled after 1977 as a result of technical committee action. These reports have not been superseded by other reports.

Copies of cancelled reports can be obtained by contacting the Library, SAE, 400 Commonwealth Drive, Warrendale, PA 15096 (412)776-4841. A charge will be made for this service. Questions regarding reports cancelled prior to 1978 should be addressed to the Technical Division at the above address.

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15	Flexible Foams Made from Polymers or Copolymers of Vinyl Chloride	1978
29	Plastic Material for Use in Housings of Motor Vehicle Lighting Devices	1983
52	Steering Wheel Rim Faceform Impact Test Procedure	1981
80	Automotive Rubber Mats	1981
106	Soil Type and Strength Classification	1982
136	Simplified Method for Simulating Glancing Blow Impacts—Motor Vehicles	1981
152	Engine Specification Tag	1980
165	Fan Blast Deflectors for Earthmoving Machines	1982
194	Drawbar for Forestry Tractors	1978
248	Crane Overload Indicating System Test Procedure	1978
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282	Automotive Gasoline Performance and Information System	1979
338	Motor Vehicle Instrument Panel Laboratory Impact Test Procedure—Knee-Leg Area	1981
346	Motor Vehicle Seatback Assembly Laboratory Impact Test Procedure—Head Area	1981
352	External Ignition-Proofing of Marine Engine Alternators	1979
353	External Ignition-Proofing of Marine Engine Regulators	1979
354	External Ignition-Proofing of Marine Engine Distributors	1979
355	External Ignition-Proofing of Marine Engine Cranking Motors	1979
364	Vehicle Identification Numbers—Motorcycles	1985
520	Fuel Supply Connections	1978
545	Generator Mountings	1984
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552	External Electromagnetic Radiation Suppressor	1982
568	Sockets Receiving Prefocus Base Lamps	1978
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623	Automotive Carburetor Flanges	1983
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660	Brake Linings	1980
685	Data Plate—Automotive Type Trailers	1981
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921	Motor Vehicle Instrument Panel Laboratory Impact Test Procedure—Head Area	1981
956	Remote and Automatic Control Systems for Construction and Industrial Machinery	1985
963	Anthropomorphic Test Device for Use in Dynamic Testing of Motor Vehicles	1979
991	Soil-Machine Terminology	1982
1010	Emission Control Hose	1983
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1258	Automotive Hydraulic Brake System—Metric Connections	1982

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SAE reports listed below in "J number" order are those reports which have been cancelled as a result of technical committee action and superseded by other reports.

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4	Motor Vehicle Seat Belt Assemblies	—	J114, 117, 140a, 141, 339a, 800c
14	Specifications for Elastomer Compounds for Automotive Applications	1980	J200
40	Automotive Brake Hoses	1969	J1400 Series
60	Rubber Cups for Hydraulic Actuating Cylinders	1977	J1600 Series
70	Hydraulic Brake Fluid	1968	J1700 Series
118	Formerly Standard SAE Carbon Steels	1984	J1249
168	Protective Enclosures for Agricultural Tractors—Test Procedures and Performance Requirements	1978	J1194
196	Electric Tachometer Specification—On Road	1984	J1399
197	Electric Tachometer Specification—Off-Road	1984	J1399
245	Engine-Rating Code—Spark Ignition	1982	J1349
270	Engine Rating Code—Diesel	1982	J1349
320	Minimum Performance Criteria for Roll-Over Protective System for Rubber-Tired, Self-Propelled Scrapers	1974	J1040
333	Operator Protection for Wheel Type Agricultural Tractors	1978	J1194
334	Protective Frame for Agricultural Tractors—Test Procedures and Performance Requirements	1978	J1194
394	Minimum Performance Criteria for Roll-Over Protective Structure for Rubber-Tired Front End Loaders and Rubber-Tired Dozers	1976	J1040
395	Minimum Performance Criteria for Roll-Over Protective Structure for Crawler Tractors and Crawler-Type Loaders	1974	J1040
396	Minimum Performance Criteria for Roll-Over Protective Structures for Motor Graders	1974	J1040
407	Hardenability Bands for Alloy H Steels	1981	J1268
414	Estimated Mechanical Properties and Machinability of Hot Rolled and Cold Drawn Carbon Steel Bars	1984	J1397
507	Helical Compression Springs Hot-Coiled for General Automotive Use	1977	J1121
508	Helical Compression and Extension Springs Cold-Coiled for General Automotive Use	1977	J1121
509	Helical Springs for Motor-Vehicle Suspension	1977	J1121

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556	Automobile Wiring	1981	J1292
558	Low Tension Cable	1978	J1127, 1128
653	Form for Transmission Compression Spring	1976	J1122
770	Alloy Steel Machinability Ratings	1984	J1397
776	Hardenability Bands for Carbon H Steels	1981	J1268
778	Formerly Standard SAE Alloy Steels	1984	J1249
787	Motor Vehicle Seat Belt Anchorage	1977	J383, 384, 385
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885	Human Tolerance to Impact Conditions as Related to Motor Vehicle Design	1981	HS J885 APR80
894	Terminology—Construction and Industrial Machinery	1978	J1234
926	Hydraulic Pipe Fittings	1979	J514 (Section IV)
977	Instrumentation for Laboratory Impact Tests	1973	J211a
1011	Performance Criteria for Roll-Over Protective Structures for Rubber Tired, Off-Highway, Non-Trailed Hauling Units with Rear or Side Dump Bodies	1974	J1040
1090	Preparation of Diesel Engines in Construction and Industrial Machinery for Operation in Cold Climate	—	HS J1093 SP 346
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1213	Glossary of Automotive Electronic Terms	1984	HS J1213
1327	Fuel Fired Engine Preheaters and Their Application	—	J1350

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SUBJECT INDEX

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Standards, Recommended Practices, and Information Reports which have been cancelled and do not appear in the Subject Index are listed in the Cancelled and Superseded Reports section of this Index Volume.

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CALIFORNIA AIR RESOURCE BOARD (CARB)

Specifications for Fuel Pipes and Openings of Motor Vehicle Fuel Tanks

SAE J829b—CARB Fuel Tank Filler Cap and Cap Retainer
SAE J1114—CARB Fuel Tank Filler Cap and Cap Retainer—Threaded Pressure—Vacuum Type
SAE J245 —CARB Engine Rating Code-Spark Ignition

ENVIRONMENTAL PROTECTION AGENCY

Title 40 CFR (40 CFR 85) Published Part J. Gaseous Emissions, Diesel Heavy Duty Engines—Paragraph 85.974–13, (a), (b), (c).

SAE J177 —Measurement of CO_2, CO, NO_x, and Diesel Exhaust
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SAE J942 —Passenger Car Windshield Washer Systems
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SAE J575e —Test for Motor Vehicle Lighting Devices and Components
SAE J588d —Turn Signal Lamps
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SAE J589 —Turn Signal Operating Units
SAE J887 —School Bus Red Signal Lamps
SAE J910 —Vehicular Hazard Signal Operating Unit
SAE J945 —Vehicular Hazard Warning Signal Flasher
SAE J1132 —142 mm x 200 mm Sealed Beam Headlamp Unit
SAE J575 —Test for Motor Vehicle Lighting Devices and Components

FMVSS-111

SAE J964a —Test Procedure for Determining Reflectivity of Rearview Mirrors

FMVSS-116

SAE J1703b—Motor Vehicle Brake Fluid

FMVSS-201

SAE J921 —Instrument Panel Laboratory Impact Test Procedure
SAE J977 —Instrumentation for Laboratory Impact Tests
SAE J839b —Passenger Car Side Door Latch Systems

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SAE J602 —Headlamp Aiming Device for Mechanically Aimable Sealed Beam Headlamp Units

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SAE J449a —Surface Texture Control

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

SAE J943a —OSHA No. 29 CFR 1910 Slow Moving Vehicle Emblem

SAE J1040b—OSHA No. 29 CFR 1926.1001 Minimum Performance Criteria for Roll-Over Protective Structures (ROPS) for Designated Scrapers, Loaders, Dozers, Graders and Crawler Tractors

SAE J1194 —OSHA No. 29 CFR 1928.51 Agricultural Tractor ROPS

SAE J208b —OSHA No. 29 CFR 1928.57 Safety of Agricultural Equipment

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HS 40—MAINTENANCE OF AUTOMOTIVE ENGINE COOLING SYSTEMS
HS 63—MANUAL ON DESIGN AND MANUFACTURE OF CONED DISK SPRINGS OR BELLEVILLE SPRINGS
HS J73—MULTIPURPOSE PETROLEUM BASE FLUIDS
HS 82—TRUCK ABILITY PREDICTION PROCEDURE—SAE J688
HS 83—TRUCK ABILITY WORK SHEET PAD
HS 83a—SAE COMMERCIAL VEHICLE ABILITY REPORT FORM
HS 84—MANUAL ON SHOT PEENING—SAE J808a
HS 87—FIBERBOARDS
HS 124—SAE MANUAL ON BLAST CLEANING—SAE J792a
HS 184—SURFACE VEHICLE SOUND MEASUREMENT PROCEDURES
HS 210—LABORATORY TESTING MACHINES AND PROCEDURES FOR MEASURING THE STEADY STATE FORCE AND MOMENT PROPERTIES OF PASSENGER CAR TIRES—SAE J1106 AND SAE J1107
HS 215—HANDBOOK OF MOTOR VEHICLE, SAFETY AND ENVIRONMENTAL TERMINOLOGY
HS J390—DUAL DIMENSIONING
HS J447 JUN81—PREVENTION OF CORROSION OF METALS
HS J670e—VEHICLE DYNAMICS TERMINOLOGY
HS J762a—REINFORCED THERMOSETTING PLASTICS FOR GROUND VEHICLE APPLICATIONS
HS J782b—SEATING MANUAL-MOTOR VEHICLES
HS J784a—RESIDUAL STRESS MEASUREMENTS BY X-RAY DIFFRACTION
HS J788 APR80—MANUAL ON DESIGN AND APPLICATION OF LEAF SPRINGS
HS J795 JUN81—MANUAL ON DESIGN AND APPLICATION OF HELICAL AND SPIRAL SPRINGS
HS J796 SEP81—MANUAL ON DESIGN AND MANUFACTURE OF TORSION BAR SPRINGS
HS J806 JUN83—OIL FILTER TEST PROCEDURE
HS J836a—AUTOMOTIVE METALLURGICAL JOINING
HS J885 APR80—HUMAN TOLERANCE TO IMPACT CONDITIONS AS RELATED TO MOTOR VEHICLE DESIGN
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HS J906—AUTOMOTIVE SAFETY GLAZING MANUAL
HS J965—ABRASIVE WEAR
HS J1066—RECOMMENDED GUIDELINES FOR COMPANY METRICATION PROGRAMS IN THE METALWORKING INDUSTRY
HS J1078—A RECOMMENDED METHOD OF ANALYTICALLY DETERMINING THE COMPETENCE OF HYDRAULIC TELESCOPIC CANTILEVERED CRANE BOOMS
HS J1086 JUN83—THIRD EDITION UNIFIED NUMBERING SYSTEM HANDBOOK FOR METALS AND ALLOYS
HS J1093 JUN82—LATTICED CRANE BOOM SYSTEMS—ANALYTICAL PROCEDURE
HS J1156 (AWS D8.6—77)—AUTOMOTIVE RESISTANCE SPOT WELDING ELECTRODES (Available only from AWS)
HS J1188 (AWS D8.7—78)—SPECIFICATION FOR AUTOMOTIVE WELD QUALITY—RESISTANCE SPOT WELDING (Available only from AWS)
HS J1196 (AWS D8.8—79)—SPECIFICATION FOR AUTOMOTIVE FRAME WELD QUALITY—ARC WELDING (Available only from AWS)
HS J1213—GLOSSARY OF AUTOMOTIVE ELECTRONIC TERMS
HS J1417—FLUID SEALING HANDBOOK—RADIAL LIP SEALS
ANSI B92.1 AND 1a—INVOLUTE SPLINES AND INSPECTION STANDARD
ANSI B92.2M—METRIC INVOLUTE SPLINES AND INSPECTION STANDARD
ANSI B92.2Ma—PART III: INSPECTION—METRIC MODULE INVOLUTE SPLINES

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HS 83a—SAE COMMERCIAL VEHICLE ABILITY REPORT FORM—Available as a single sheet for reproduction or may be purchased in quantity.

$1.00 Mem. $2.00 List

HS 84—MANUAL ON SHOT PEENING—SAE J808a—Intended as a practical aid to engineers, designers, and men in the shop. HS 84 points out some of the possibilities and some of the limitations of the process. Chapters are devoted to a description of the process, the effect of shot peening, shot peening machines, peening media, quality control, fatigue properties, and x-ray diffraction.

$8.00 Mem. $10.00 List

HS 87—FIBERBOARDS—This publication is a reprint of the reports appearing in the Nonmetallic Materials section of the SAE Handbook. Among the topics covered are: Fiberboard Terminology; Test Procedure; Crease Bending Test; Flammability of Automotive Interior Materials; and numerous test methods.

$8.00 Mem. $10.00 List

HS 124—SAE MANUAL ON BLAST CLEANING—SAE J792a—Instructs engineers, designers, and shop men in blast cleaning know-how. Discusses blasting abrasives, blast cleaning machines, production procedures, and process specifications.

$8.00 Mem. $10.00 List

HS 184—SURFACE VEHICLE SOUND MEASUREMENT PROCEDURES—This publication includes an extensive rationale statement to accompany SAE Recommended Practice J184a—Qualifying a Sound Data Acquisition System. Recognizing that the use of only a sound level meter is often impractical or insufficient, there is need to ensure that other systems meet the performance requirements of a standard meter. J184a recognizes recent advancements in sound measurement instrumentation and provides the means to qualify the newer systems to existing performance criteria. The rationale behind the modification of the qualification procedure is explained in detail. In addition to complete systems, the requirements for individual instruments and circuit components are also discussed. HS 184 also includes all of the standards and recommended practices found in the sound level section of the SAE Handbook.

$12.00 Mem. $15.00 List

HS 210—LABORATORY TESTING MACHINES AND PROCEDURES FOR MEASURING THE STEADY STATE FORCE AND MOMENT PROPERTIES OF PASSENGER CAR TIRES—SAE J1106 and SAE J1107—These reports describe some basic design requirements and operational procedures associated with equipment for laboratory measurement of tire force and moment properties for the full range of automotive tires. These properties must be known to establish the tires' contribution to vehicle dynamic performance. This HS is a guide for equipment design and test operation so that data from different laboratories can be directly compared.

$10.00 Mem. $12.00 List

HS 215—HANDBOOK OF MOTOR VEHICLE, SAFETY AND ENVIRONMENTAL TERMINOLOGY—Includes alphabetical listings of more than 1500 technical terms as defined within the Motor Vehicle, Safety and Environmental areas of the 1976 SAE Handbook. Available for the first time in an easy to use format, these definitions were compiled to fill the critical need for a single-source reference. HS 215 is one of the most useful Handbook Supplements ever published by the SAE.

$12.00 Mem. $15.00 List

HS J390—DUAL DIMENSIONING—With the rapidly growing use of metric measurement throughout the world, the need for both metric and inch dimensions on a single drawing has led to growing use of dual dimensioning of engineering drawings. This report presents several approaches to displaying and identifying the two different values for each dimension, although only one is shown as preferred.

$6.00 Mem. $8.00 List

HS J447 JUN81—PREVENTION OF CORROSION OF METALS—SAE Information Report. A guide to principles of metal corrosion and methods of dealing with its prevention. Materials are described and evaluated. Chemical treatments are covered along with metal coatings, paints, and ceramics.

$15.00 Mem. $18.00 List

HS J670e—VEHICLE DYNAMICS TERMINOLOGY—SAE Recommended Practice. Defines mechanical vibration—qualitative terminology, vibrating systems, components and characteristics of suspension systems, vibrations of vehicle suspension systems, suspension geometry, tires and wheels, and directional control. (1978)

$8.00 Mem. $10.00 List

HS J762a—REINFORCED THERMOSETTING PLASTICS FOR GROUND VEHICLE APPLICATIONS—This information report established an engineering approach to selection and use of reinforced plastic materials. Also acquaints engineers with varied classes of fibrous reinforced plastic

materials available and their general range of properties and applications.

$8.00 Mem. $10.00 List

HS J782b—SEATING MANUAL–MOTOR VEHICLES—Developed by the SAE Seating Committee, this manual is designed to provide a more uniform system of nomenclature, definition of functional requirements, and test methods for the various materials, components, and manufacturing methods used in automotive seating. The information compiled is for reference for body and trim engineers as well as those who work cooperatively with the engineers.

$8.00 Mem. $10.00 List

HS J784a—RESIDUAL STRESS MEASUREMENTS BY X-RAY DIFFRACTION—This manual brings together the most important aspects of the x-ray techniques. It places emphasis on theoretical aspects but at the same time attempts to show how these theoretical considerations are reduced to a practical technique. Techniques are presented which enable satisfactory measurements of stress even when diffraction lines are diffused. Techniques are based on two-exposure method and use of diffractometers.

$10.00 Mem. $12.00 List

HS J788 APR80—MANUAL ON DESIGN AND APPLICATION OF LEAF SPRINGS—A complete design and application guide for leaf springs, this manual covers space requirements, elastic and geometric properties, proper methods of attachment, and much more.

$18.00 Mem. $22.00 List

HS J795 JUN81—MANUAL ON DESIGN AND APPLICATION OF HELICAL AND SPIRAL SPRINGS—A detailed design manual on all aspects of helical and spiral springs, this book covers fatigue, durability, temperature effects on springs, common causes of spring failure, a detailed listing of spring materials, and more, for a variety of types of helical and spiral springs.

$18.00 Mem. $22.00 List

HS J796 SEP81—MANUAL ON DESIGN AND MANUFACTURE OF TORSION BAR SPRINGS—This design guide provides detailed information on all types of torsion springs, including fatigue life, applications, material and processing, adjustment mechanisms, end fastening design, and much more. It even includes examples of actual applications.

$18.00 Mem. $22.00 List

HS J806 JUN83—OIL FILTER TEST PROCEDURE—The purpose of this lubrication oil filter test code is to provide means for evaluating the performance characteristics of full-flow oil filters on bench test equipment. This data collected from "in service" applications may be used for establishing standards of performance for filters tested in this manner.

$12.00 Mem. $15.00 List

HS J836a—AUTOMOTIVE METALLURGICAL JOINING—This report is an abbreviated summary of metallurgical joining by welding, brazing, and soldering, intended to reflect current usage in the automotive industry.

$8.00 Mem. $10.00 List

HS J885 APR80—HUMAN TOLERANCE TO IMPACT CONDITIONS AS RELATED TO MOTOR VEHICLE DESIGN—SAE Information Report. This excellent information report provides a wide variety of data on human tolerance to impact resulting from tests of human volunteers, cadavers, and animal subjects. Its purpose is to provide a basis for crash test evaluation and motor vehicle accident reporting and it meets these needs well. It should, however, also be valuable to anyone involved in any type of trauma or accident investigation or product safety evaluation. Definitions are provided for medical terminology used.

$8.00 Mem. $10.00 List

HS J905—FUEL FILTER TEST METHOD—SAE Recommended Practice. This recommended practice provides a complete description of the procedures for testing final fuel filters for both diesel and gasoline engines. Test apparatus and testing materials are described in detail. An effort has been made in developing this test to simulate actual operating conditions.

$8.00 Mem. $10.00 List

HS J906—AUTOMOTIVE SAFETY GLAZING MANUAL—SAE Information Report. Provides a basic guide to characteristics of safety glazing materials and information on usage for those unfamiliar with glazing.

$6.00 Mem. $8.00 List

HS J965—ABRASIVE WEAR—SAE Information Report. Covers fundamentals of abrasive wear phenomena, testing for abrasive wear resistance, and solutions to abrasive wear problems.

$6.00 Mem. $8.00 List

HS J1066—RECOMMENDED GUIDELINES FOR COMPANY METRICATION PROGRAMS IN THE METALWORKING INDUSTRY—This 40 page booklet is divided into four sections: Drawing Practices; Units, Applications, and Terminology; Education and Training Aids; and Machine and Inspection Tools. Each of these sections recommends practices that will promote effective use of metric units, as well as effective handling of the transition period. Lists are included showing supplier of materials and where to obtain additional information.

$8.00 Mem. $10.00 List

HS J1078—A RECOMMENDED METHOD OF ANALYTICALLY DETERMINING THE COMPETENCE OF HYDRAULIC TELESCOPIC CANTILEVERED CRANE BOOMS

$8.00 Mem. $10.00 List

HS J1086 JUN83—THIRD EDITION UNIFIED NUMBERING SYSTEM HANDBOOK FOR METALS AND ALLOYS—The UNS provides a quick and easy way to cross reference the many different numbering systems used to identify metals and alloys. It includes over 3500 metals and alloys designations used by individual societies, trade associations, governmental bodies, and metals and alloys producers and users. Information can be located by document number, sponsoring organization, or metal/alloy.

$65.00 Paper $75.00 Case

HS J1093 JUN82—LATTICED CRANE BOOM SYSTEMS—ANALYTICAL PROCEDURE—This SAE Recommended Practice establishes the criteria for analytically evaluating the basic structural competence of wire rope supported latticed crane boom systems. Included is the evaluation of elastic stability for the overall boom system and the individual members of the system.

$8.00 Mem. $10.00 List

HS J1213—GLOSSARY OF AUTOMOTIVE ELECTRONIC TERMS—Revised in November 1982, this book contains over 600 automotive electronic terms and definitions.

$12.00 Mem. $15.00 List

HS J1417—FLUID SEALING HANDBOOK—RADIAL LIP SEALS—First in a series of Fluid Sealing Handbooks, this edition focuses on elastomeric radial lip seals and covers application considerations, seal design, material selection, inspection and testing, performance, and industry recommended practices.

$20.00 Mem. $25.00 List

ANSI B92.1 AND 1a—INVOLUTE SPLINES AND INSPECTION STANDARD—Details all standardized size- and major-diameter fit splines. Sidefit splines are subject of major changes. New table format aids referencing.

$18.00 Mem. $22.00 List

ANSI B92.2M—METRIC INVOLUTE SPLINES AND INSPECTION STANDARD—Provides details of all standardized metric splines including dimensions, tolerances, and fit information.

$20.00 Mem. $25.00 List

ANSI B92.2Ma—PART III: INSPECTION—METRIC MODULE INVOLUTE SPLINES—The purpose of this standard is to provide guidance and data for the inspection of straight (non-helical) cylindrical involute splines. Contents include: inspection with limit gages, positions and values of dimensional tolerances for spline gages, dimensions, designation and marking of gages, and analytical inspection.

$10.00 Mem. $12.00 List

SP-407—DRIVER EXPECTANCY AND PERFORMANCE IN LOCATING AUTOMOTIVE CONTROLS—Final report of research on automotive control location conducted for the Vehicle Research Institute of the SAE. This research was undertaken to provide information that can be used to develop recommended practices and convention for the location of certain hand-operated controls in passenger cars, light trucks, and multi-purpose vehicles.

$15.00 Mem. $18.00 List

SP-423—GLOSSARY OF AUTOMOTIVE TERMINOLOGY/FRENCH–ENGLISH—ENGLISH–FRENCH—Developed by the Chrysler Corporation's Engineering Office. Included are approximately 17,000 entries. Accents and annotations for parts of speech, gender, and number appear in the French half. The annotations have been added to all single word entries, and to the first word (key word) of some multi-word entries.

$15.00 Mem. $18.00 List

SP-436—GLOSSARY OF AUTOMOTIVE TERMINOLOGY/SPANISH–ENGLISH—ENGLISH–SPANISH—Developed by the Chrysler Corporation Engineering Office. It contains more than 27,000 entries in each language, complete with accents and annotations indicating verbs. English entries applying only to the U.S. or Great Britain are so noted. Because of its value to the automotive community, it is being published for worldwide distribution by SAE.

$18.00 Mem. $22.00 List

SP-450—ANTHROPOMETRY OF INFANTS, CHILDREN, AND YOUTHS TO AGE 18 FOR PRODUCT SAFETY DESIGN—Truly a landmark publication, this book is a must for anyone involved in designing safety systems, restraint systems, controls, or a variety of products or systems to be used by those in infancy through age 18. Range of measurements, average measurements, and scatter frequencies are provided for a long list of physiological dimensions including sitting height, standing height, weight, hand and finger size, hip width, arm length, and much more. Prepared for the U.S. Consumer Product Safety Commission by the Highway Safety Research Institute.

$30.00 Mem. and List

J-REPORTS

Rules, Nomenclature and Guideposts

TECHNICAL COMMITTEE GUIDEPOSTS—SAE J1271 AUG79

SAE Recommended Practice

Report of Publications Advisory Committee approved August 1979.

1. Introduction

1.1 These Guideposts were written to provide information needed by SAE technical committee members. Subject matter covers relations of technical committees to the SAE organization and, in broad terms, committee operating procedures.

1.2 The *Guideposts* are the outgrowth of the principles and policies of the Society, and they reflect the philosophies, traditions, and methodology that have emerged from years of successful operations of SAE technical committees.

1.3 These Guideposts are necessarily brief and presented in an outline form. For additional information refer to the latest issue of the SAE Technical Board Rules and Regulations and appropriate Council Operating Practices.

2. SAE Objective

2.1 The objective of the Society is to promote the Arts, Sciences, Standards, and Engineering Practices connected with the design, construction, and utilization of self-propelled mechanisms, prime movers, components thereof, and related equipment. SAE serves its members and the General Public through meetings and programs developed by its various Engineering Activities and Sections, through its Placement Committee, and through its publications; *it serves industry, government, and the public through the development of technical reports*[1] *including engineering standards and recommended practices, and distributing these documents.*

3. SAE Technical Board

3.1 Organization—The Technical Board is the agent of the SAE Board of Directors with authority to direct and supervise all SAE Cooperative Engineering Programs, including standardization, research, and the participation in technical committee activity of other organizations. Fig. 1 shows its position in the Society's structure, the councils, and a few examples of technical committees it administers.

3.2 Philosophies

3.2.1 The Technical Board will consider those projects for which industry, government, the public, or other responsible agencies have expressed a need and which lend themselves to cooperative solution. Within their own operations, technical committees frequently generate projects meeting the above-noted criteria.

3.2.2 The Technical Board expects technical committees to set up their own organizations, procedures, and programs within their scopes and the limits of the Technical Board's *Rules and Regulations* and individual council guidelines.

3.3 Recognition of Achievements—Annually the Board awards a maximum of 30 *Certificates of Appreciation* to technical committee members and to individuals representing SAE in other organizations. Nominations for awards are submitted through the councils to the Certificates of Appreciation Committee by the various technical committees. Supporting data outlining the basis for nomination is required.

4. Councils of the SAE Technical Board

4.1 The Technical Board delegates to its councils the authority to direct and approve (see paragraph 6.2) SAE Standards, Recommended Practices, and Information Reports (subject to the right of anyone to appeal a decision to the Board). The councils are authorized to establish committees that may be needed to accomplish this assignment.

[1] The term "technical reports" as used in these Guideposts, stands for the end product of a committee's efforts and may consist of an SAE Standard, Recommended Practice, Information Report, or Aerospace Material Specification.

4.2 Committee Sponsor—It is intended that the chairman of each council appoint annually council members to act as sponsors for committees functioning directly under the council. The council chairman may appoint the council technical committee chairmen as members of the council and as sponsors for their committees. The committee sponsor shall represent the committee to the council, and serve as liaison between the committee and the council. During periods when a committee is without a sponsor, the council chairman will perform such functions.

4.2.1 Committee sponsor's responsibilities shall include:

(a) Providing regular communication of significant committee activity to the council and council actions to the technical committees. To facilitate communication, a sponsor report should be included as an agenda item at each technical committee meeting. Each technical committee chairman should prepare an annual status report for submission to the council through his sponsor. (The date for this report to be selected to be convenient to council meetings and national meetings.) Time should be provided on the council agenda for discussion of these reports with the sponsors.

(b) Reviewing and counseling with committee chairman on committee programs and membership and providing council policy guidance.

(c) Providing coordination among sponsor's assigned committees and with other sponsors.

(d) Reviewing technical committee organization and proposing appropriate changes to the council.

5. SAE Technical Committees

5.1 Objectives—The objectives of a technical committee are to coordinate and utilize the knowledge, experience, and skill of engineers and other qualified individuals on technical problems within the scope of its activities to:

(a) Conduct necessary investigations and develop technical reports.

(b) Review technical reports periodically, revise as necessary, and maintain content abreast of latest technology.

(c) Advise, consult, and cooperate with industry, government, educational institutions, the public, other standardizing bodies, and other SAE committees and members.

(d) Assist committees of the SAE Engineering Activity Board (see Fig. 1) in the preparation and presentation of papers at national meetings and specialty conferences.

5.2 Principles—The end products of the committee's work are offered as the best judgment of a group technically competent to deal with the problems covered and do *not* represent an industry-trade position. Employers of committee members are not committed by an action of an SAE committee. Over many years, the extensive use of SAE technical reports clearly indicates that committee members, working as individuals, do produce results that are practical and useful to industry, government, and the public.

5.3 Scope—A technical committee shall be responsible for a field of endeavor, as defined by its scope. In cases where projects overlap areas of interest of another council's committee, the originating committee shall submit the project(s) for review and approval to the other concerned committee and its council prior to issuance. A committee is established when a new major project area is to be undertaken and no existing commitee is available. A committee is discharged when the assigned work is completed and there is no further need for its services. The councils retain responsibility for periodic review of technical reports developed by their disbanded committees.

5.4 Membership

5.4.1 QUALIFICATIONS—All participants are appointed to SAE technical

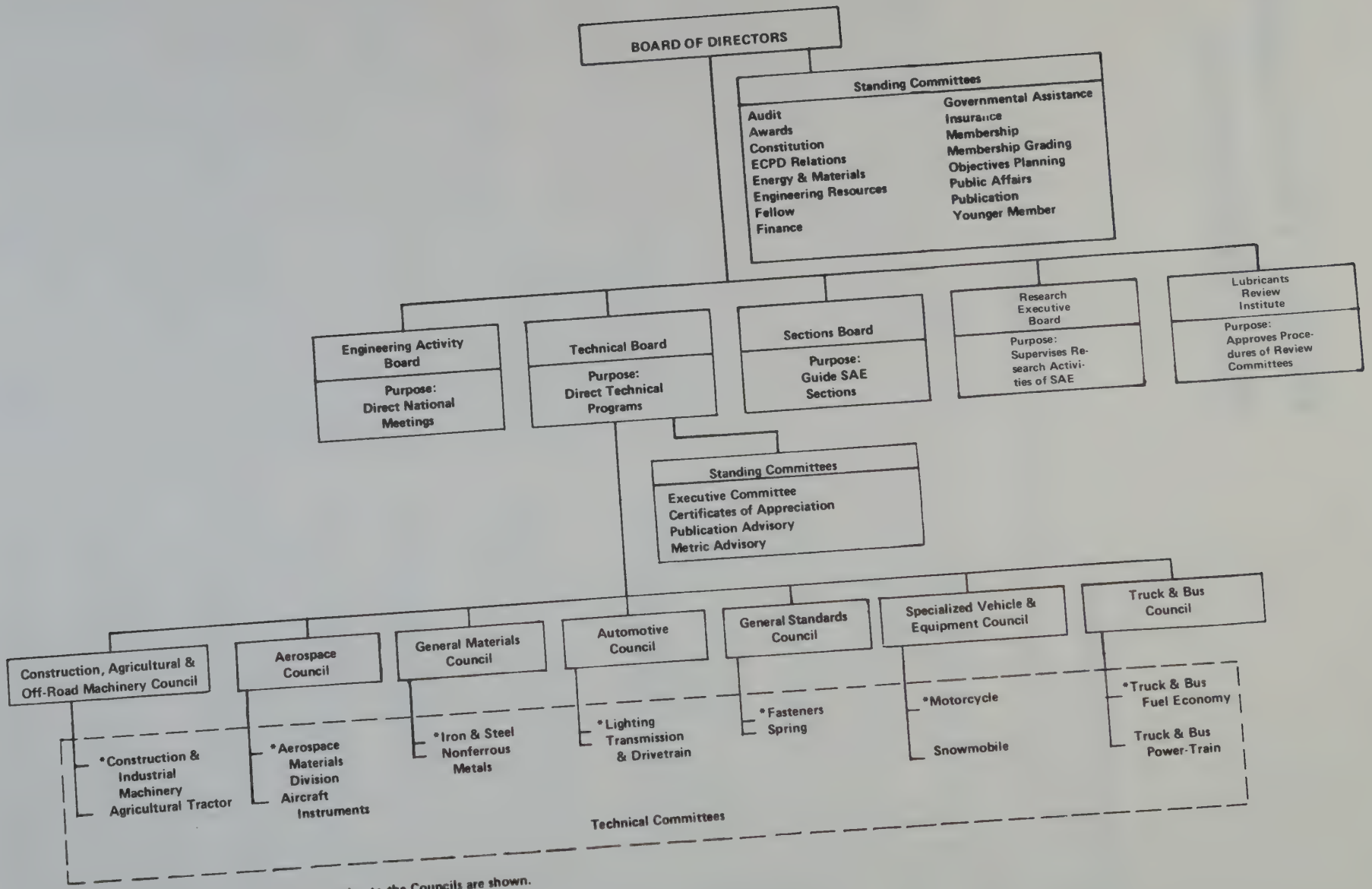

FIG. 1—SAE ORGANIZATION

committees by the committee chairman on the basis of their individual qualifications which enable them to contribute to the work of these committees. Overall, committee membership should attain an equitable balance of representation by knowledgeable *parties at interest.* All relevant points of view should be invited to participate. (Ref. paragraph 4.1.1 Technical Board Rules and Regulations.) SAE membership is not a prerequisite for committee membership.

5.4.2 The policy of the Society is that SAE technical committee members act as *individuals* and not as agents or representatives of their employers. Their actions are accepted as personal actions and do not necessarily represent their employers' attitudes or views.

5.4.3 Grades—In addition to committee officers (see paragraph 5.5.1), committee participants shall be classified as *member, liaison member,* and *consultant member.*

5.4.4 *Liaison and consultant members* are appointed by the chairman on the basis of need for their particular services. *Liaison members* relay information to and from paralleling activities of other committees and organizations. *Consultant members* supply advice on the specific program for which they have been appointed. *Liaison* and *consultant members* are not eligible to vote on committee actions except at the request of the committee chairman.

5.4.5 Governmental agency employees may be appointed as *members, liaison members,* or *consultant members* of the committee with aforementioned responsibilities and privileges.

5.5 Organization—The number of members on a technical committee may vary depending on the specific needs. Typical organization patterns are shown in Figs. 2 and 3.

5.5.1 Officers—The committee shall have a chairman and may have a vice-chairman and/or a secretary.

5.5.1.1 The chairman and vice-chairman of a newly formed committee shall be appointed by the council chairman with advice of council members. Existing committees shall nominate a chairman and vice-chairman annually for council approval. (See paragraph 4.3 of SAE Technical Board Rules and Regulations). The chairman may become a member of a council by appointment by the council chairman.

5.5.1.2 The secretary shall be appointed annually by the committee chairman.

5.5.1.3 Reasonably frequent rotation of committee chairmen, where practical and desirable, is encouraged. However, renominations of chairmen who have served five or more consecutive years shall be reviewed and approved by the council.

5.5.1.4 It is the duty of the chairman to:

(a) Plan and conduct committee meetings.

(b) Establish subcommittees, appoint their chairmen, and supervise their operation.

(c) Establish working panels, including appointment of their chairmen and/or individual member work assignments, and supervise their operation.

(d) Assign projects so as to balance and expedite the committee's work.

(e) Act for the committee between meetings, subject to confirmation at the next meeting.

(f) Supervise and report voting on all committee reports. (See paragraph 5.5.2.1 for responsibilities of SAE staff representative.)

(g) Review the membership annually to maintain an active and balanced committee.

(h) Recommend revisions of committee procedures as needed.

(i) Arrange for the nomination of candidates for the Technical Board Certificate of Appreciation Award. Candidates must be nominated by April 1 (see paragraph 3.3).

(j) Serve as chairman of the steering committee (or executive committee), if applicable.

(k) For additional duties of the chairman, refer to SAE J1159, Preparation of SAE Technical Reports—Surface Vehicles and Machines: Standards, Recommended Practices, Information Reports.

5.5.2 SAE Staff Representative—An SAE staff representative will advise the committee officers on procedures and assist the committee in its organization and operation, attend meetings, and assure that meeting minutes are prepared and properly distributed.[2]

5.5.2.1 SAE staff representative performs tally of committee voting and disseminates results of balloting.

5.5.3 Executive Committees (Fig. 2)—When a technical committee has numerous subcommittees, projects, or is so large as to make meetings of the entire group impractical, an executive committee may be established to organize and manage the affairs of the committee. The executive committee shall include all committee officers, and may include all subcommittee chairmen and such additional members as may be desirable to form an efficient working group. The technical committee officers shall be the officers of the executive committee.

5.5.4 Subcommittees—Subcommittees are organized to carry out specific continuing technical segments of the committee's scope. The original chairman shall be appointed by the parent technical committee chairman; thereafter, the chairman may be nominated by the subcommittee, subject to review and approval by the parent technical committee chairman. It is desirable that the subcommittee chairman be a member of the parent committee.

5.5.4.1 The original membership will be appointed by either the parent committee chairman or by the subcommittee chairman. Thereafter, membership matters are handled by the subcommittee chairman.

5.5.4.2 Duties of subcommittee officers in relation to their subcommittees are the same as those of the technical committee officers in relation to the technical committee, except for paragraph 5.5.1.4, items b, i, and j.

5.5.5 Working Technical Panels (Fig. 3)—When a committee or subcommittee wishes to have several of its members work together in preparation of a draft technical report, a temporary working panel may be formed. After completion of its task, responsibility for review and maintenance of resulting technical reports reverts to the committee or subcommittee, and the panel is discharged.

5.6 Committee Relationships with SAE and Non-SAE Groups

5.6.1 Intra-SAE Relationships—As a primary principle, each SAE technical report should be reasonably self-contained or cross-reference other SAE documents. Development of a draft technical report will often require use of data which falls within the scope of another SAE committee. In these instances, liaison should be established by formation of a joint sub-group, by membership on or from that committee, or through the SAE staff. In any event, comments and/or approval by the consultant committee should be solicited by the committee preparing the draft technical report. Adherence to this principle will avoid duplication of effort and will insure against conflicts and ambiguities. Because of his intimate knowledge of SAE activities, the SAE staff representative can help the technical committee in its relationships with other Society groups. See paragraph 6.6 in SAE J1159.

5.6.2 Liaison with Other Organizations—Technical committees should coordinate their efforts with parallel activities in other organizations such as the American National Standards Institute, American Society for Testing and Materials, American Iron and Steel Institute, American Petroleum Institute, and the Aerospace Industries Association. To maintain this liaison, the Technical Board appoints individuals to represent the Society. It is the duty of these representatives to report developments to the appropriate SAE committee, and to present SAE views which are the consensus of the concerned SAE committee(s) to these organizations.

5.6.2.1 Representatives of SAE on American National Standards committees or standards committees of other standards writing organizations shall be appointed by the Chairman of the SAE Technical Board.

5.6.2.2 Representatives of SAE on non-SAE standards committees shall report to a technical committee or, if none exists, to the appropriate council.

5.6.2.3 Representatives of SAE shall, where feasible, develop SAE positions regarding draft technical reports developed by such non-SAE committees through consultation with the appropriate SAE technical committee or council.

5.6.2.4 The representative of SAE shall report activities of the non SAE committee annually and shall advise the technical committee or council of the SAE vote on approval or disapproval of standards or other substantive matters coming before the non-SAE committee. The SAE representative may seek additional SAE support in backing up the SAE position through the appropriate SAE committees and councils.

5.6.2.5 Approval of American National Standards by American National Standards committees for which SAE is sponsor, co-sponsor, or secretariat shall be by the appropriate SAE council on either recommendation of the appropriate SAE committee or the SAE representatives on the American National Standards commitee.

5.6.2.6 Upon approval by SAE of an American National Standard for which SAE is *sponsor, co-sponsor,* or *secretarial,* the subject standard shall be considered an approved SAE Standard. In the event that SAE is not the publisher of the subject standard as an American National Standard, but does provide coverage of the subject matter contained in the standard in the SAE handbook or other SAE publications, such SAE publications will be revised as soon as possible after SAE approval of the American National Standard but not later than one year after such approval. When SAE coverage of the subject matter is approved in advance of a revision to the American National Standard, the Society will immediately initiate a revision of the American National Standard.

5.6.3 Joint Sponsorship with Other Organizations—SAE joint sponsorship of committees with outside organizations is discouraged, unless such joint sponsorship is of direct benefit to SAE committees. Where possible, SAE

[2]When the chairman or his appointed secretary records the minutes, a copy (or copies, as appropriate) should be forwarded to the SAE office where they will be reviewed and distributed and maintained for at least five years and made available for inspection and for distribution as appropriate.

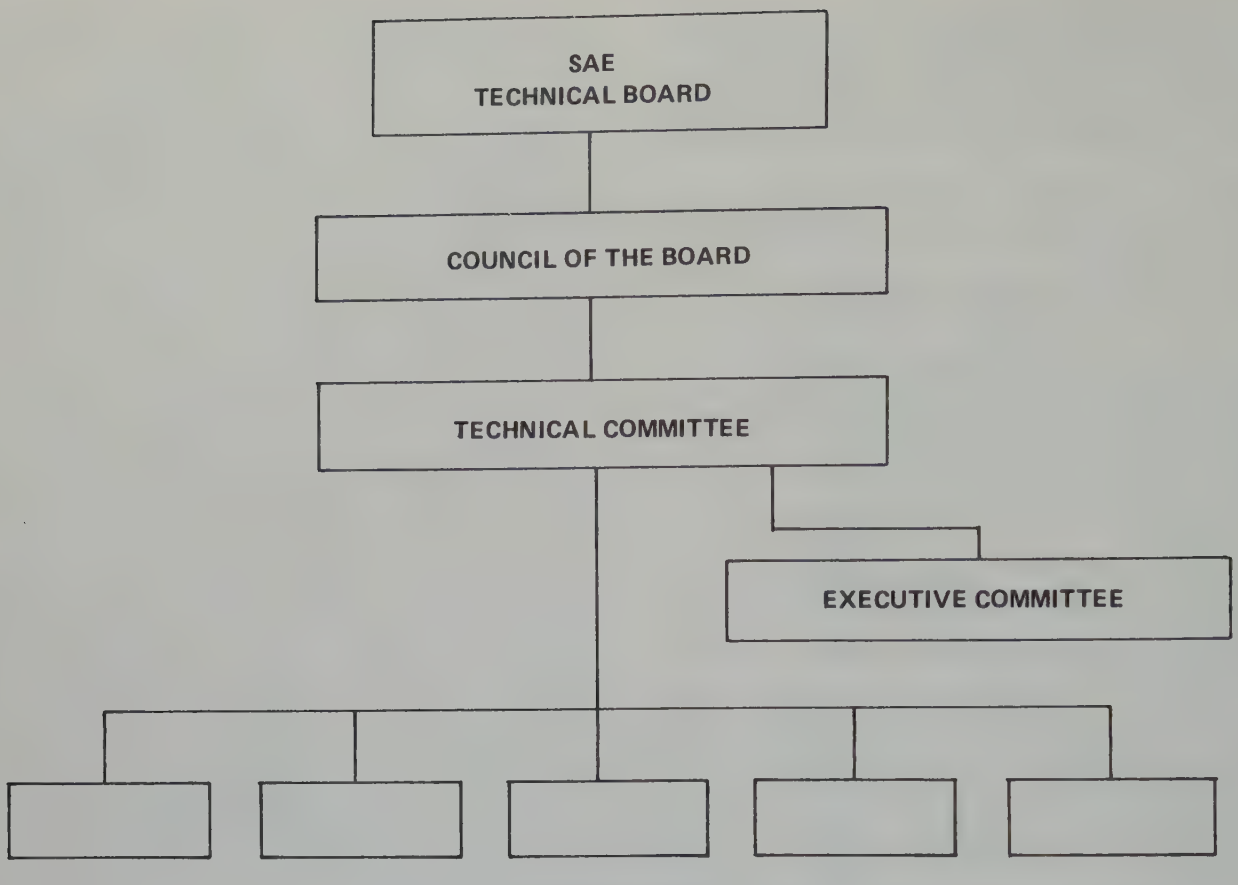

FIG. 2—EXAMPLE OF EXECUTIVE COMMITTEE OF LARGE TECHNICAL COMMITTEE

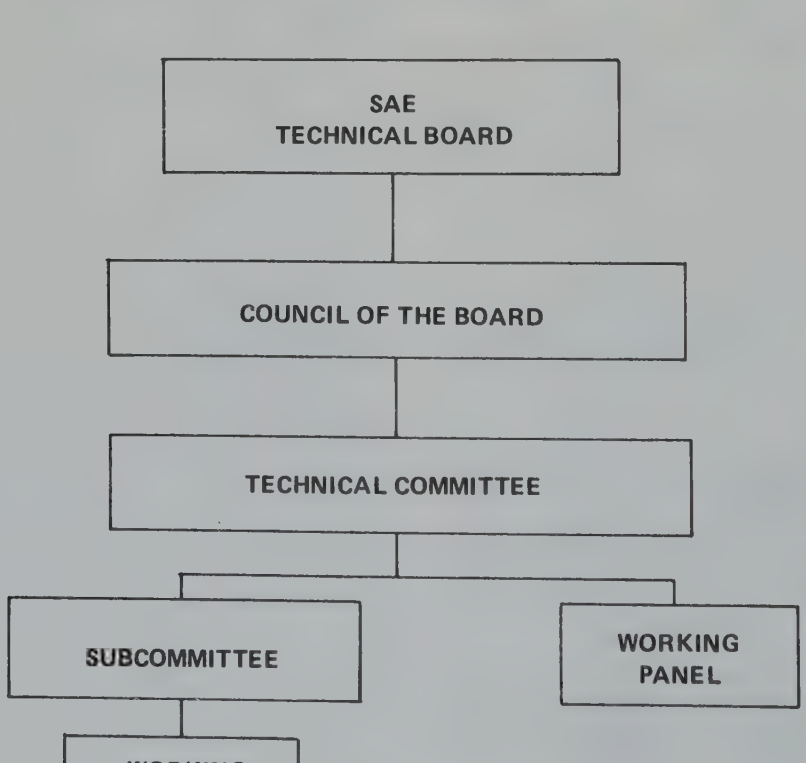

FIG. 3—TECHNICAL COMMITTEE

should perform its standardization and cooperative engineering functions without the establishment of jointly sponsored groups.

5.6.3.1 In cases where SAE technical committee work or technical projects are of major interest outside of SAE (for example, splines and screw threads), cooperation is encouraged in established SAE sponsored organizations such as the American National Standards Institute (ANSI) and the Coordinating Research Council (CRC).

5.6.3.2 Where joint sponsorship of a project with an outside organization is proposed, specific Technical Board approval is required.

5.6.3.3 Any technical reports resulting from such cooperative activity will be subject to normal SAE review and approval procedures. In such technical reports recognition of the participation of outside groups is appropriate.

5.6.4 Cooperation with Government Agencies—Technical committee cooperation with government agencies in developing technical reports of mutual interest is encouraged. Such technical reports will be identified by normal SAE numbering systems when published by the SAE, and appropriately cross-referenced when issued in some other manner.

5.6.4.1 Where there is a divergence of technical opinion on a proposed technical report between a committee and interested governmental agency, the committee may offer the government its technical opinion in the form of comments upon a proposed government prepared specification or standard.

5.6.4.2 If the committee so chooses, and with review and approval by the appropriate council, the committee's technical opinion can be published in the form of an SAE technical report.

5.6.5. SAE Participation in International Standards

5.6.5.1 SAE may serve as the U. S. technical secretariat for ANSI in International Organization for Standards (ISO) and International Electro-Technical Commission (IEC) technical committees, subcommittees, and working groups only when approved by the Technical Board.

5.6.5.2 In administering such ISO and IEC technical secretariats, SAE shall form a U. S. Technical Advisory Group (TAG) consistent with procedures of the American National Standards Institute. Membership on the TAG shall follow the rules governing membership on SAE technical committees. Appointments to the TAG shall be subject to confirmation by the appropriate SAE council. The TAG will call upon cognizant SAE technical committees and outside activities, if appropriate, to assist in developing U. S. positions on proposed ISO or IEC standards and in the development of draft standards.

5.6.5.3 SAE shall follow the provisions of the ANSI Guidelines for ISO Standards Activities.

6. Technical Committee Technical Reports—The major effort of technical committee activity is the development of technical reports for publication by the SAE.

6.1 Development—The initial work on a draft technical report is usually handled by a task force which presents its work to a parent group, preferably well in advance of a meeting date. Corrections to the proposal are officially recognized at the meeting of the parent group and documented in the minutes. Depending on procedures established for each group, mailing of draft technical reports may be handled directly by the chairman, the SAE staff representative, or by a delegated member.

6.1.1 Guides for Preparation of Technical Reports—Annually, a large number of documents are developed by the technical committee for publication. It is not practical for the SAE staff to restyle them. Technical committees will use the following SAE publications.

(a) *Preparation of SAE Technical Reports*—Surface Vehicles and Machines: Standards, Recommended Practices, Information Reports—SAE J1159.

(b) *Rules for SAE Use of SI (Metric) Units*—SAE J916—establishes the rules for the use of Système International (SI) units in SAE documents including specifications and standards.

(c) *AMS Editorial Procedure and Form* for the preparation of Aerospace Material Specifications (AMS) and other Aerospace Material Documents

(d) *Aerospace Council's Organization and Operating Guide for Aerospace Cooperative Engineering Program* for the preparation of Aerospace Standards, Military Standards, Aerospace Recommended Practices, and Aerospace Information Reports.

6.1.2 Committee Correspondence—It is required that all correspondence within and between committees be classified by subject so that it may be readily identified. Copies of committee correspondence should be sent to the chairman and SAE staff representative. Committees shall use technical committee correspondence forms which are available, upon request, from the SAE staff representative. Committees shall not use stationery with a company or business letterhead.

6.2 Approval—Draft technical reports submitted to a council for approval, in general, should have the unanimous approval of the committee making such a submittal. Where unanimous approval cannot be achieved, draft technical reports shall have the approval of at least three-quarters of the responding committee members who have not waived their vote. Dissenting views, including those of liaison and consulting members shall accompany draft technical reports when they are circulated to the council for final review and approval prior to publication. The committee's reasons for not accepting the dissenting views should be included.

6.2.1 Committee draft technical reports shall normally require confirmation by letter ballot, except when they are submitted for final voice vote approval. In such instances the draft technical reports shall be distributed to the members of the voting group at least two weeks prior to the meeting. Where a single draft technical report is a joint project of two committees reporting to separate councils, it shall be submitted to both councils for review and approval.

6.2.2 The Technical Board retains the authority for final review and approval when dissenting views cannot be reconciled.

6.3 Publication and Timing—After approval by the council, the technical report will be published at the earliest opportunity.

6.3.1 The preparation of technical reports intended for publication in the SAE Handbook should be scheduled so that council approval can be obtained prior to the closing date set by the Publications Advisory Committee. At least three weeks should be allowed for circulating drafts to the councils. Timing on technical reports which are to be released in loose-leaf or pamphlet form is not as critical with respect to publication date. The SAE staff representative should be consulted as required, to determine target dates.

6.4 Distribution and Use—A basic tenet of SAE technical committee operating policy is that technical reports produced by technical committees are advisory in nature. The use of such technical reports by industry, government, or other responsible agencies is entirely voluntary.

6.4.1 Early recognition by the SAE membership of new or revised technical reports is highly desirable. This provides better service for members, government, and the public, and may result in beneficial comment leading to further improvement. For these reasons, information should be submitted by the technical committee chairman to SAE *AUTOMOTIVE ENGINEERING* as a news item, or, if the technical report has wide appeal, it may be given more extensive treatment. With a view to providing increased service, notice of all new and revised technical reports will appear as soon as possible after council approval in *AUTOMOTIVE ENGINEERING* mazazine.

6.5 Review—Every technical report shall be reviewed at least every five years. The staff advisor shall initiate such reviews. At such reviews, the technical report may be reaffirmed, revised, or canceled. If reaffirmed, no formal ballot of the affected council is needed, but the council should be informed of the action. Regular balloting of the council is required for a revision or cancellation.

7. Some General Considerations for Technical Reports—SAE technical reports are to be limited to technical and engineering considerations. They are not to include provisions that are of a commercial nature such as prices, warranties, allocation of risk of loss or conditions of acceptance or rejection, nor are such considerations to be a basis for SAE documents.

7.1 Minimum Requirements—SAE technical reports should be written in terms of performance rather than design so as not to exclude any technically adequate equipment, product, design, material, or process. Where technical requirements are established to achieve a stated purpose, such requirements should be the minimum required to achieve such purpose. In terms of standardization or interchangeability of products, only that portion of the product necessary to accomplish such standard or interchangeability should be specified in the document. When a specific product, design, material, or the like is known not to conform to the requirements or conditions of an SAE technical report applicable to the same class of products, designs, materials, or the like, the reasons (in terms of performance characteristics) for such failure are to be set forth in the minutes or files of the appropriate SAE committee together with all data supporting the conclusions of the committee.

7.2 Two Users—An SAE technical report for a particular product, design, material, or process should only be undertaken when there are two or more interested users, unless the only user in the government and the activity is undertaken at the request of an appropriate agency of the government.

7.3 Source of Supply—It is desirable that technical reports not contain a reference to sources of supply of parts or products, or the identity of manufacturers. Where a committee finds it necessary to specify a particular brand of product, such specification is to be accompanied by the statement *or equivalent.*

7.4 Other Society or Association Product Listings—An SAE technical report may reference a list of products that has been developed by other recognized organizations; however, in such case the source of the list is to be clearly identified. A statement is to be made that the listing is included only for the convenience of the user and does not indicate either approval by SAE or the technical committee or its fitness for purposes specified.

7.4.1 An example of a completely referenced technical report is the SAE Information Report, Special Purpose Alloys ("Superalloys")—SAE J467.

7.4.2 An example of a partially referenced technical report is the SAE Standard, Road Vehicle—Hydraulic Brake Hose Assemblies for Use with Non-Petroleum Base Hydraulic Fluids—SAE J1401.

7.5 Test Materials—A particular product or material may be identified by name when it is essential to uniformity in testing. In such cases, an *or*

equivalent statement should be added to the company product or material referenced.

7.6 Patents and Copyrights—The committees in developing a technical report are not to consider whether the subject matter set forth is patented or copyrighted. However, if the committee is aware of any copyrights applicable to published material then such material shall not be used in the technical report. In the event it is known by the committee that following the teachings of a technical report will probably result in the infringement of a patent, the committee is to set forth criteria which will permit the user to conform to the technical report without infringing such patent.

7.6.1 Notice on all Technical Reports—Every approved technical report shall carry the following statements: *All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade or their use by governmental agencies is entirely voluntary. There is no agreement to adhere to any SAE Standard or Recommended Practice, and no commitment to conform to or be guided by any technical report. In formulating and approving technical reports, the Technical Board, its councils, and committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against liability for infringement of patents, trademarks, and copyrights.*

PREPARATION OF SAE TECHNICAL REPORTS—SURFACE VEHICLES AND MACHINES: ϕSTANDARDS, RECOMMENDED PRACTICES, INFORMATION REPORTS—SAE J1159 AUG79

SAE Recommended Practice

Report of Publications Advisory Committee approved July 1976 and completely revised August 1979.

1. Foreword—This SAE Recommended Practice has been developed by the Publications Advisory Committee of the SAE Technical Board. The Publications Advisory Committee was formed as the Publications Policy Committee of the Technical Board in 1956. The objectives of the committee are (1) to guide and promote efficient dissemination of material produced under the Technical Board and (2) to recommend immediate and long-range policies to the Technical Board to assure that Technical Board information will be available to those who need it in a form suitable for their work.

2. Purpose—The purpose of this recommended practice is to establish a uniform practice for technical committees for the preparation of technical reports.

3. Scope—It applies to reports of Surface Vehicles and Machinery Technical Committees only. Aerospace technical reports are covered by editorial practices of the Aerospace Council. Close adherence to this recommended practice by technical committees of SAE will help to assure uniform technical reports. Should questions on format, style, or other matters pertaining to the organization and editorial practices of technical reports be raised within technical committees of the Technical Board, they should be referred to the Chairman of the Publications Advisory Committee for interpretation or for discussion by the full Publications Advisory Committee.

4. Technical Committee Chairman Responsibilities

4.1 A technical committee chairman is responsible for seeing that his committee and all subcommittees or working group members understand their responsibilities relative to publications, particularly:

(a) Accuracy of technical content and references,

(b) Conformance to policies and guidelines outlined in this report, and

(c) Clearance through technical committee chairman of all subcommittee or committee work, whether major or minor (including editorial changes and corrections). It is the chairman's responsibility to see that the following actions are taken relative to technical reports.

4.1.1 Classification—This shall be recommended by the time technical agreement has been reached on the content of the report. See Section 5 of this report.

4.1.2 Legal Aspects—The report shall be checked against rules prepared by the Society's legal counsel. See Technical Committee Guideposts, SAE J1271, Section 7.

4.1.3 Publication Method—This shall be recommended based on the following methods.

4.1.3.1 *SAE Handbook*—The Handbook is used for technical reports (Standards, Recommended Practices, and Information Reports) of value to a substantial number of SAE members.

4.1.3.2 *Handbook Supplements*—Supplements are used for descriptive or educational material of broad interest to SAE members and other engineers in the automotive and allied industries. They are also used to provide groups of related technical reports from the SAE Handbook.

4.1.3.3 *Separate Reports*—A properly approved technical report may be issued separately in addition to publishing in the Handbook, either because the subject is timely and must not wait for the next Handbook issue, or because of major interest.

4.1.4 Organization and Format—The draft of the report shall be prepared using details given in Section 6 of this report.

4.1.5 Metrication—The report shall be checked to make sure that metric units have been included or used as the basis for the report. Details of use shall be checked for conformance with Rules for SAE Use of SI (Metric) Units, SAE J916.

4.1.6 Key Index Words—Along with the report, the committee shall submit a list of key words to provide a basis for index preparation by staff. A list of 3–10 words is suggested, depending on the nature of the report. Instructions are given in Section 7 of this report.

4.1.7 Explanation of Proposed Report—When the report is submitted to a council of the Technical Board, a statement shall be included outlining:

(a) Significance of report,

(b) Background information (rationale),

(c) Reason for choice of classification, and

(d) Recommendation for method of distribution.

The statement will be retained in the committee file by the SAE Technical Division.

4.1.8 Cut-Off Date—When beginning the final approval process, the approved committee draft report should be submitted to SAE staff in time to meet the deadline for publication of the Handbook. Time must be allowed for approval by a cognizant council of the Technical Board and submittal of final report draft and transmittal to the Publications Division by June 30 of each year. Staff should be consulted on adequate lead time.

5. Classification and Numbering of Technical Reports[1]

5.1 Classification—Technical reports are approved for publication by the Technical Board, and must be based on sound technology and cooperative engineering work. Before publication, a report must be classified into one of the following three classifications: (See paragraph 4.1.1 of this report.)

5.1.1 SAE Standards—These reports are a documentation of broadly accepted engineering practices or requirements for a material, product, process, procedure, or test method.

5.1.1.1 A product standard may be primarily a descriptive standard covering dimensions, composition, and other details or it may be a functional or performance standard, or both.

5.1.1.2 Performance standards involve requirements or levels against which the functions can be evaluated. This frequently involves the need to define test methods by which these requirements are measured. Preferably, performance standards and test procedure standards should be in separate reports. If this is not practical, they should be in separate sections of the same report. Where performance standards are given, it is desirable to publish the rationale simultaneously as an SAE Information Report in order to provide all users with the basis for selection of performance levels.

5.1.2 SAE Recommended Practices—These reports are documentation of data that are intended as guides to standard engineering practice. Their content may be of a more general nature, or they may propound data that have not yet gained broad acceptance.

5.1.2.1 A technical committee preparing such a report may add an introductory note stating, "This SAE Recommended Practice is intended as a guide toward standard practice but may be subject to frequent change to keep

[1]The Society also approves and issues reports for the aerospace industry. These are called Aerospace Standards (AS), Aerospace Recommended Practices (ARP), Aerospace Information Reports (AIR), and Aerospace Material Specifications (AMS). Their definitions are similar to the above.

pace with experience and technical advances, and this should be kept in mind when considering its use."

5.1.3 SAE Information Reports—These reports are compilations of engineering reference data or educational material useful to the technical community.

5.1.4 Examples

5.1.4.1 *Standard*—Automotive Carburetor Flanges, SAE J623. A product standard based on dimensions.

5.1.4.2 *Recommended Practice*—Surface Texture Control, SAE J449. Description of the techniques of control, including preparation of standards, etc.

5.1.4.3 *Information Report*—Mechanical Properties of Heat Treated Steels, SAE J413. General information giving guidance on the relationship of various properties.

5.2 Numbering—Prior to submission to the appropriate council of the Technical Board, SAE staff will assign a "J" number to all reports.

5.2.1 Suffixes—When a technical report is approved by a council or the Technical Board, the report "J" number will be supplemented by a date suffix (e.g., SAE J1159 AUG79).[2] This date suffix should be shown in all indexes and should be used as appropriate in references. (See paragraph 6.6 of this report.) The date suffix will be advanced for each technical or editorial revision.

5.2.2 Integrity of SAE "J" Numbers—Changes to an SAE Standard or Recommended Practice which alter it sufficiently to affect its interchangeability or interchangeable application shall require a new "J" number identity. The superseded "J" number shall continue to exist unless retired. When an SAE technical report is retired, its "J" number shall continue in the index with its date suffix, classification, a cross reference to any superseding "J" number, and an indication of its last date and method of publication.

6. Guide for Preparation of Technical Reports

6.1 Organization of Report—The following recommendations for items to be included in SAE technical reports are all-inclusive. Accordingly, all items may not be required for every type of report. In addition, the sequence in which they are presented herein may be changed, for good reason, by the responsible technical committee.

6.1.1 Title—Each report shall have a title which does not duplicate an existing title. It should be as short, concise, and descriptive as possible.

6.1.2 Report Classification—See Section 5 of this report.

6.1.3 Approval Note—Includes credit to originating committee, original approval date, and date of last revision or reaffirmation. Latest editorial revision, if any, is included. For example: Report of the Iron and Steel Technical Committee, approved April 1963, last revised June 1975, editorial change March 1979.

6.1.4 Introduction (as applicable)—The introduction shall provide the basis for data or information in the report, background or general description of the report, and a brief explanation of changes from previous version of the report.

6.1.5 Purpose and/or Scope (as applicable)—If both are used, the purpose shall precede the scope. The purpose will explain the objectives or end to be obtained by use of the report. The scope will briefly give the extent of treatment and applicability of the report.

6.1.6 Definitions, Glossary of Terms, Terminology, and Designations—All definitions, glossary, terminology, and designations should be reviewed for consistency with SAE reports; SAE Motor Vehicle and Machinery, Safety and Environmental Terminology, HS215, and Guidelines for Developing and Revising SAE Nomenclature and Definitions, SAE J1115.

6.1.7 Test procedures including:

6.1.7.1 Description of facilities and environment.

6.1.7.2 Listing of instrumentation and equipment. (Where instruments must be identified by brand name, the phrase *or equivalent* must be used.)

6.1.7.3 Details for installation of instrumentation and equipment and preparation required for vehicles or machinery, test samples or components.

6.1.7.4 Forms for data sheets, graphs, and reports.

6.1.8 Dimensional data, including tables and charts.

6.1.9 General specifications which augment dimensional data.

6.1.10 Illustrations, photographs.

6.1.11 Performance requirements (if not included in a separate document)—See paragraph 6.5 of SAE Technical Board Rules and Regulations for reservations on performance requirements.

6.1.12 Component materials and mechanical and physical properties.

6.1.13 Inspection requirements.

6.1.14 Appendices—As applicable, to add supplementary engineering reference data or educational material not an integral part of the basic technical report. They may also be issued as a separate SAE Information Report.

6.1.15 Rationale—The rationale which accompanies a technical report when being sent to upper committees for approval may be included as an Appendix or may be the subject of a separate SAE Information Report. The rationale will provide an expanded explanation of the purpose and scope of the technical report; an explanation of the reasons for decisions, conclusions, and recommendations; and a report on actual tests made which support conclusions and recommendations or which provide the basis for performance criteria.

6.1.16 References—List all SAE technical reports and other standards referenced in the report.

6.1.17 Bibliography (as required)—A list of publications from which authoritative information was gathered for inclusion in the report.

6.2 Preparation of Technical Reports

6.2.1 Paragraph Numbering—A decimal numbering system should be used where practical to aid organization in long or complicated reports. Use decimal point to indicate successive subheadings (Example: 1., 1.1, 1.1.1).

6.2.2 New Reports—Double space drafts of new reports. Mark and date each successive draft legibly.

6.2.3 Revisions to Existing Reports[3]—Revisions may be handled in several ways. The best method depends upon the extent of the revisions. A major revision, for example, would probably best be handled by complete retyping as in paragraph 6.2.2. Other approaches in handling are:

(a) Cut and paste or mark copies of printed report, indicating deletions and insertions clearly.

(b) Double space new copy, describing clearly where it is to be inserted in existing report.

6.3 Artwork—These instructions are based on a 50% reduction for final size. A one-column figure has a final maximum width of 92 mm (3.62 in). Largest maximum final width is 178 mm (7.00 in).

(a) Typewriter lettering and pencil drawings are unacceptable as both fade and drop out in reproduction process. Please use ink.

(b) Clear, sharp glossy prints of specified original artwork are acceptable if originals must be kept in committee's files.

6.3.1 Line Drawings (excluding graphs)

Main lines—Equiv. O Leroy pen (0.3 mm width)

Inside lines
Dimension line leaders
Phantom line, etc. } Equiv. 00 Leroy pen (0.2 mm width)

6.3.2 Graphs—The heaviest line weight used on graphs should be the curves.

Curves—Equiv. 1 Leroy pen (0.4 mm width)

Ordinate and Abscissa—Equiv. 0 Leroy pen (0.3 mm width)

Grid lines
Tic marks } Equiv. 00 Leroy pen (0.2 mm width)

6.3.3 Lettering (excluding section and reference letters)—All lettering to be capitals unless lower case letters are necessary for a specific term. Lettering shall be vertical except for quantity symbols which shall be in italics. Use only Roman alphabet, except where letters are recognized standard symbols.

6.3.3.1 All lettering should be placed outside visible outline of part. Label, with line and arrowhead to area being identified, should be kept reasonably close to figure.

6.3.3.2 Lettering, including Greek, numbers, fractions: 120 Leroy—Equiv. 00 pen (0.120 in [3.05 mm] letter height).

6.3.4 Section and Reference Letters—All section and reference letters: 140 Leroy—Equiv. 0 pen (0.140 in [3.56 mm] letter height).

6.3.5 Numbers—Align column of numbers on decimal point.

6.3.6 Abbreviations—Do NOT use ″, ′, or ° (angular). Use in, ft, deg.

6.4 Tables—Tables shall be numbered consecutively throughout the report, and referred to in the text. Each shall be titled.

(a) Concise descriptions, measurement units, and letter symbols shall be included in column headings.

(b) Be concise in numerical ranges. Do not overlap ranges or leave gaps in ranges. An example of good practice is:

0.75 thru 1.25 mm
Over 1.25 thru 2.00 mm
Over 2.00 thru 3.25 mm

6.5 Decimal Dimensioning—The dimensions in all new and revised SAE technical reports shall be expressed in decimal units. Nominal sizes shall be expressed as decimals or fractions, as determined by their design basis or historic use. Where these considerations are not decisive, decimal nominal sizes will be used.

6.5.1 The number of significant digits used in a dimension should relate to the precision of the quantity stated. This is particularly important in decimalizing dimensions previously expressed as fractions. A dimension of $1\frac{3}{16}$ with an intended precision of about ± 0.01 shall be decimalized as 1.19, not 1.1875.

[2] The practice of using date suffixes for SAE technical reports is initiated with the issue of J1159 AUG79. The previous practice of using suffix letters will be phased out as SAE technical reports are revised. (Note: Date suffixes will be phased in in the 1981 SAE Handbook.)

[3] See paragraph 6.9.

A discussion of the precision of a value, and the number of decimals proper to retain, is given in Rules for SAE Use of SI (Metric) Units, SAE J916.

6.5.2 Rounding Off—When it is necessary to reduce the number of decimals by rounding off, the method shown in SAE J916 shall be used.

6.5.3 Zeros—Where decimal values less than 1 appear, a zero shall be placed to the left of the decimal point.

6.6 Cross-Referencing—As necessary, other SAE reports or reports of other organizations may be referenced.

6.6.1 References shall be made to other standards or technical reports by name of the standards writing organization, number of the standard, and optimally the date of issue (e.g., SAE J804 FEB79; ASTM D1405 JUN78). If date is included, it is assumed that a specific report is being referenced even though it may be obsolete.

6.6.2 Where references are made, the referencing committee shall notify the committee responsible for maintaining the referenced technical report and request that the referencing committee be furnished with drafts of any proposed changes to the referenced report. Such drafts shall be sent to the chairman and SAE staff advisor of the referencing committee.

6.6.3 If the proposed changes are acceptable to the referencing committee, the chairman of the referencing committee should notify the committee responsible for the referenced technical report. The referencing technical report should then be revised to reflect the latest date of the referenced technical report.

6.6.4 If the changes are unacceptable to the referencing committee, the chairman of the referencing committee should notify the committee responsible for the referenced technical report that the proposed changes have affected applicability of the referenced report and a determination should be made between the two committees whether or not a new document number is required.

6.6.5 As an aid to committees and users of SAE Technical Reports, SAE staff shall maintain a listing of cross-referenced technical reports. The listing should give access to both the referenced and referencing technical reports.

6.6.6 If the SAE technical report corresponds to but is not identical to a technical report of another organization, it should be stated in the approval note. Example: This report conforms essentially to American National Standard B18.2.

6.6.7 Joint development of a technical report should be indicated in the approval note. Example: This is a joint report of SAE and ASTM . . .

6.7 Use of Basic Terms

6.7.1 Surface Vehicle or Machine—The term *surface vehicle* or *machine* is preferred to *automotive* for use in identifying technical reports which do not apply to the aerospace industry.

6.7.1.1 *Vehicle*—The term *vehicle* pertains to self-propelled devices for carrying passengers, goods, or equipment . . . a car, bus, truck, or boat.

6.7.1.2 *Machine*—The term *machine* pertains to self-propelled or mobile devices designed to alter or transmit energy and force for the performance of useful work . . . tractor, loader, grader, ditcher, combine.

6.7.2 Mechanical Properties—Mechanical properties are those properties of a material that pertain to its elastic and plastic behavior when force is applied: For example, yield strength, ultimate strength, elongation, hardness, etc.

6.7.3 Physical Properties—Physical properties are those properties other than mechanical properties that pertain to the physics of a material: For example, density, electrical conductivity, thermal expansion, etc., often improperly used to express mechanical properties.

6.7.4 Use of *Shall* or *Should*—The use of *should* or *shall* has no bearing on the voluntary nature of SAE technical reports. Inclusion of an SAE technical report in a document, standard, or contract by a company or agency is a voluntary act. When a technical report is so cited, the report becomes a requirement within the limitations set forth by the document, standard, or contract. The following shall apply to use of these words:

Shall—*Shall* is to be used wherever the criterion for conformance with the specific recommendation requires that there be no deviation. Its use shall not be avoided on the grounds that compliance with the report is considered voluntary.

Should—*Should* is to be used wherever noncompliance with the specific recommendation is permissible. *Should* shall not be substituted for *shall* on the grounds that compliance with the report is considered voluntary.

6.7.5 Use of *Safe* and *Safety*—The words *safe* and *safety* shall be used in SAE technical reports only when they are in whole or in part commonly used engineering terms, such as: fail-safe, factor of safety, safety glass. To preclude any misinterpretation of the words *safe* and *safety,* more definite descriptive words shall be used, such as:

"lock wiring" rather than "safety wiring" . . .

"lock nut" rather than "safety nut" . . .

"relief valve" rather than "safety valve" . . .

"the integrity of the painted surface" rather than "the safety of the painted surface" . . .

"to provide protection against shock" rather than "to provide safety against shock" . . .

"will provide for reliable transportation of the component" rather than "will provide for safe transportation of the component."

If circumstances arise which strongly indicate a need for the use of the words *safe* or *safety,* the Publications Advisory Committee shall be consulted.

6.8 Measurement Unit Symbols and Abbreviations—These may be found in Rules for SAE Use of SI (Metric) Units, SAE J916.

6.9 Indicating Revisions to SAE Standards, Recommended Practices, and Information Reports

6.9.1 Indications of Technical Revisions—In drafts of revisions to existing "J" reports, the symbol ϕ shall be used to indicate technical changes.[4] A technical change requires a change in the date suffix, that is, JXXX JUN75 to JXXX JUN79. This indication of change shall be put on the draft revision at the earliest circulation.

6.9.1.1 The ϕ symbol is always placed in the left margin for single column copy and in the left- or right-hand margin, respectively, for double column copy. It is used to indicate change in text, tables, or figures. In the case of text, a separate symbol is used for each paragraph. In the case of tables or figures, the symbol is used once for each table or figure. In no case should it be located where it might be confused with the international symbol for *diameter,* which has a similar appearance.

6.9.1.2 Should the revision be so extensive that most of the report is changed, the symbol is put next to the title of the report, and the history note under the title shall read "completely revised (date)".

6.9.1.3 The ϕ symbol will be carried on the published document. If the document is again revised, the old symbols are deleted and new ones appropriate to the new technical revision are added.

6.9.1.4 The SAE Handbook and any separately published "J" reports will carry the following explanatory note: "The ϕ symbol is for the convenience of the user in locating the areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report."

6.9.2 Editorial Revisions—Editorial revisions shall be indicated in both draft and published technical reports by the symbol *ed.* The history note under the report title will also call out editorial revisions by the following: "Editorial change (date)". The ϕ symbol indicating last technical revisions shall be retained.

7. Indexing Information—Following are instructions to assist in providing key words for use by SAE staff in preparing SAE Handbook index.

7.1 Selection—Terms chosen should be taken directly or derived from the material being indexed on the basis of their relative significance and effectiveness in later retrieval of needed information. Terms should be used consistently. Terms should be as specific as the nature of the material and user's requirements allow.

7.2 Clarity—Subject terms should be nouns. Avoid terms that will not be recognized, coined terms, jargon, and slang. Generally the plural form should be used. Terms should be clarified if they have more than one accepted meaning, or must show distinction from other subject terms. This may be done by compound terms such as metal tubing, plastic tubing, or a parenthetical qualifying expression appended to distinguish the homographs as Tolerances (Mechanics) and Tolerances (Physiology).

7.3 Word Order—Terms consisting of two or more words should be listed in their natural word order, that is: Lighting equipment not Equipment, Lighting. When two or more candidate terms are true synonyms, one should be selected as the preferred index term, the other(s) entered as a see reference, that is, air cleaners use air filters, cloth use fabrics.

7.4 Punctuation—Punctuation marks should be used in index terms only when essential.

7.5 Abbreviation—Abbreviated word forms, including acronyms, should be used only when meanings are well established or when significant convenience results.

7.6 Inversions—For committee consideration, inverted entries, that is Engines, Aircraft, or Engines, Passenger Car, etc., make it possible to find most members of a related class together for ease of retrieval. The terms to be inverted must be carefully selected and care taken that another useful grouping is not scattered by inversion.

8. References—Available from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pennsylvania 15096:

Technical Committee Guideposts, SAE J1271 AUG79.

SAE Handbook.

Rules for SAE Use of SI (Metric) Units, SAE J916.

Standard—Automotive Carburetor Flanges, SAE J623.

Recommended Practice—Surface Texture Control, SAE J449.

Information Report—Mechanical Properties of Heat Treated Steels, SAE J413.

[4] Symbol made on a typewriter by a combination of a zero and a slash.

SAE Motor Vehicle, Safety and Environmental Terminology, HS 215.
Guidelines for Developing and Revising SAE Nomenclature and Definitions, SAE J1115.
SAE Technical Board Rules and Regulations.
SAE J804.
Available from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103:
ASTM D 1405—Estimation of Net Heat of Combustion of Aviation Fuels.
Available from the American National Standards Institute, 1430 Broadway, New York, New York 10018:
American National Standard B18.2.

RULES FOR SAE USE OF SI (METRIC) UNITS—SAE J916 JUN82

SAE Recommended Practice

Report of the Publication Policy Committee, approved June 1965, fifth revision prepared by the Metric Advisory Committee June 1982.

1. Introduction—In the spring of 1969 the SAE Board of Directors issued a statement that "SAE will include SI[1] units in SAE Standards and other technical reports." Much investigation has attended the determination of units of measure for use, since measurement practice all over the world is to some degree in a state of transition. Engineering use of measurement units in nearly every metric country of the world, and in all of those nations adopting metric units, is confronted with the struggle between the noncoherent technical metric units, such as kilogram-force and calorie, and the SI units, such as newton and joule.

This document establishes the rules for the use of SI units in SAE reports, including specifications and standards. It must be remembered that a technical committee may produce its reports in any units it feels are proper for the users—U. S. inch-pound, SI, or other metric. However, if the units used do not conform to the Units Approved for SAE Use (see paragraph 2), they must be followed by approved SI units in parentheses.

Throughout this document, SI is intended to include recognized SI units as established by the international General Conference on Weights and Measures,[2] (CGPM) and a limited number of other units that are not formal SI units.

These other units are all included in the American National Standard Z210.1, "Standard for Metric Practice," in "The Metric System of Measurement" issued by the Secretary of Commerce in the 10–26–77 Federal Register, and in ISO 1000, the worldwide document for use by all ISO[3] committees.

By careful contact with other countries, the General Conference, and ISO, this document will be updated as often as necessary to keep the use of SI units in SAE reports as nearly as possible in harmony with the units that will be adopted for United States and world use.

2. Units Approved for SAE Use—All SAE documents produced under the Board of Directors' directive to "include SI units" must utilize as applicable:

2.1 Base Units of SI

Quantity	Unit (symbol)
length	—meter[4] (m)
mass	—kilogram (kg)
time	—second (s)
electric current	—ampere (A)
thermodynamic temperature	—kelvin (K)
amount of substance	—mole (mol)
luminous intensity	—candela (cd)

2.2 Supplementary Units of SI

Quantity	Unit (symbol)
plane angle	—radian (rad)
spherical angle	—steradian (sr)

2.3 Recognized Derived Units of SI with Special Names

Quantity	Unit (symbol)	Formula
absorbed dose	—gray (Gy)	J/kg
activity (of a radionuclide)	—becquerel (Bq)	$1/s$, s^{-1}
Celsius temperature	—degree Celsius (°C)	[5]
dose equivalent	—sievert[6] (Sv)	J/kg
electric capacitance	—farad (F)	C/V
electric conductance	—siemens (S)	A/V
electric inductance	—henry (H)	Wb/A
electric potential diff.	—volt (V)	W/A
electric resistance	—ohm (Ω)	V/A
energy, work	—joule (J)	N·m
force	—newton (N)	$kg \cdot m/s^2$
frequency	—hertz (Hz)	$1/s$, s^{-1}
illuminance	—lux (lx)	lm/m^2
luminous flux	—lumen (lm)	cd·sr
magnetic flux	—weber (Wb)	V·s
magnetic flux density	—tesla (T)	Wb/m^2
power	—watt (W)	J/s
pressure or stress	—pascal (Pa)	N/m^2
quantity of electricity	—coulomb (C)	A·s

See Z210.1 paragraph 2, for more complete description.

2.4 Other Units that May be Used with SI

Quantity	Unit (symbol)
plane angle	—degree (°) (decimal divisions preferred)
time	—minute (min), hour (h), day (d), week, and year
mass	—metric ton (t)
area	—hectare (ha)
sound pressure level	—decibel (dB)
volume	—liter[4] (L)[7]
navigation velocity	—knot (kn)[8]
distance	—nautical mile (nmi)[8]

When these units are used, they need not be followed by SI units unless it suits the purpose of the document.

The liter which the General Conference established as a special name for the cubic decimeter, is approved for SAE use, and the only prefixed ϕ use allowed is mL.

In the case of time, committees are urged to use the second and its multiples, but the units given above are permitted.

The unit metric ton (exactly 1 Mg) is in wide use but should be limited to commercial description of vehicle mass, or freight mass, and no prefix is permitted.

The unit hectare (exactly 1 hm^2) is restricted to land and water area measurement.

[1] SI—The International System of Units (Système International) officially abbreviated "SI" in all languages—the modern metric system.

[2] CGPM Resolutions and Recommendations are published in NBS Special Publication 330, "The International System of Units (SI)."

[3] The International Organization for Standardization.

[4] Spelling with "re" is also used.

[5] In 1976 the CIPM decided that "degree Celsius" is a special name to be used instead of "kelvin" to express Celsius temperature. For formula see paragraph 8.

[6] Approved by CGPM in 1979.

[7] In 1979 the CGPM approved the symbol "L" for liter and it is recommended for North American use. The alternative symbol "l" will also be used during a transition period.

[8] Abbreviation, not a symbol.

2.5 Other derived units that are formed from those units and derived units indicated above are also acceptable. For example, the SI unit designation for electric field strength is V/m; however, it is also expressed in terms of base units as $kg \cdot m/(s^3 \cdot A)$ or $kg \cdot m \cdot s^{-3} \cdot A^{-1}$. Likewise, torque and bending moment (N·m) may also be expressed as $kg \cdot m^2/s^2$ or $kg \cdot m^2 \cdot s^{-2}$.

3. Units Not Approved for Use as SI—Gravimetric force units, such as kilogram-force, or kilogram-force per square millimeter, which have been common in some countries, must not be used in SAE reports. Similarly, calorie, bar, angstrom, and dyne are not SI units and are not to be used. However, as stated in Section 1, this restriction does not preclude use of these units where a committee considers them to be the proper units for the users of the report, and provided they are followed with approved SI units in parentheses.

4. Multiplying Prefixes—Table 1 lists the prefixes to be used with SI units, observing the rules given in Section 5.

5. Rules for Use of Units

5.1 Requirements of this document establish the use of SI units in one of the following manners:

5.1.1 As regular units.

5.1.2 As regular units followed by other units in parentheses.

5.1.3 In parentheses following other units.

5.1.4 Under special circumstances it is permissible to deviate from these rules. See Appendix B.

5.2 SI units must be those shown in Appendix A or their decimal multiples, except as covered in paragraph 6.2. In case of need for other units the Metric Advisory Committee of the SAE Technical Board should be consulted. If units for quantities not included in Appendix A and not clearly covered by paragraph 6.2 are required, the above committee should be contacted for guidance.

An apparent anomaly exists in the use of the joule for work (J = N·m) and the use of N·m for torque or bending moment. These are, however, entirely different units. In the former, the unit of work results from unit force moving through unit distance. In the latter, there is no implication of movement, and unit force acts at right angles to the lever arm of unit length. This would be readily seen if vectors were incorporated in the unit symbols. For these reasons, it is important to express work or energy in joules. Moment of force, torque and bending moment are expressed in newton meters, not joules.

5.3 Use of Prefixes

5.3.1 Use of prefixes representing 10 raised to a power that is a multiple of 3 is recommended. In the case of prefixed units that carry exponents, such as units of area and volume, this may not be practical, however, and any listed prefix may be used.

5.3.2 Compound prefixes, such as milli-micro, are never used.

5.3.3 In general, prefixes in the denominator of a compound unit should be avoided except for established usage. (Since the kilogram is a base unit of SI, use of kg in the denominator is not contrary to this guidance.)

5.3.4 When expressing a quantity by a numerical value and a unit, prefixes should preferably be chosen so that the numerical value lies between 0.1 and 1000. This is, of course, not true where certain multiples and units have been agreed to for particular use, such as kPa for pressure, or where tabular use requires the same unit in a series, even though this means exceeding the preferred range of 0.1–1000.

5.3.5 The prefix becomes a part of the symbol or name with no separation (meganewton, MN).

5.3.6 Errors in *calculations* can be minimized if all quantities are expressed in SI units, and prefixes are replaced by powers of 10.

TABLE 1—SI UNIT PREFIXES

Multiples and Submultiples	Prefixes	Symbols	Pronunciations
10^{18}	exa	E	ex′a
10^{15}	peta	P	pet′a
10^{12}	tera	T	ter′a
10^{9}	giga	G	ji′ga
10^{6}	mega	M	meg′a
10^{3}	kilo	k	kil′o
10^{2}	hecto	h	hek′to
10	deka	da	dek′a
10^{-1}	deci	d	des′i
10^{-2}	centi	c	sen′ti
10^{-3}	milli	m	mil′i
10^{-6}	micro	μ	mi′kra
10^{-9}	nano	n	nan′o
10^{-12}	pico	p	pe′co
10^{-15}	femto	f	fem′to
10^{-18}	atto	a	at′to

5.3.7 With SI units of higher order, such as m^2 or m^3, the prefix is also raised to the same order; for example, 1 mm^3 is $(10^{-3}\ m)^3$ or $10^{-9}\ m^3$.

5.4 Symbols and Abbreviations

5.4.1 Distinction—The distinction between unit symbols and unit abbreviations is not always recognized, particularly with certain U. S. inch-pound units of measurement. The symbols for some U. S. units are also abbreviations (ft, in, yd). In many cases the unit symbol and the abbreviation are not the same (such as unit symbol ft^3/min and abbreviation cfm; unit symbol A and abbreviation amp; unit symbol in^3 and abbreviation cu in). A positive distinction exists between unit symbols and unit abbreviations: the SI unit symbol designation is the same in all languages whereas abbreviations are conventional representations of words or names in a particular language; they may be different in different languages.

5.4.2 Unit Symbol Composition—Unit symbols are letters or groups of letters predominantly from the English alphabet representing the units in which physical quantities are measured (m for meter, W·h for watthour). Non-English alphabet unit symbols are (Ω) for ohm, (°) for the plane angle degree or used with the Celsius (°C) temperature scale, and (μ) for the prefix micro. All unit symbols are printed in roman (upright) type.

5.4.3 Unit Symbol Style[9]—Unit symbols are, in general, shown as lower case letters. If, however, the symbol is derived from a proper name, it or the first letter (where more than one) is an upper case letter (Hz, Wb, Pa). An exception to the above permits the upper case (L) to represent the unit liter because of the confusion that can occur between the lower case unit symbol (l) and the number one (1).

The letter style must be followed for SI unit symbols and prefixes even in applications where all other lettering is upper case (such as technical drawings). The only exception allowed is for computer and machine displays with limited character sets. For symbols for use in systems with limited character sets, refer to ANSI X3.50 or ISO 2955. The symbols for limited character sets must never be used when the available character set permits the use of the proper symbols as given herein.

5.4.4 Quantity Symbols—Quantity symbols must not be confused with unit symbols. Quantity symbols are single letters representing the magnitude of physical quantities (*I* for electric current, *e* for charge of an electron). The established symbol must always be maintained (*f*—frequency, *F*—force, *m*—mass, *M*—moment of force).

Quantity symbols are single letters of the English or Greek alphabet, and are printed in italic (slanting) type.

5.4.5 Abbreviations—Abbreviations are shortened forms of words or phrases formed in various ways that have been accepted and established (ANSI Y1.1). They are generally letters from the word being abbreviated, except where the abbreviation is taken from another language (no for number, lb for pound). Abbreviations are never to be used when a mathematical operation sign is involved, unless the abbreviation is also the symbol.

5.4.6 Symbolized Compound (Derived) Units[9]—Compound (derived) units constitute a mathematical expression. Where compound units include the solidus (/), it must not be repeated in the same expression. In complicated cases, negative powers or parentheses should be used. For example, write: m/s^2 or $m \cdot s^{-2}$ but not m/s/s; or write $kg \cdot m/(s^3 \cdot A)$ or $kg \cdot m \cdot s^{-3} \cdot A^{-1}$ but not $kg \cdot m/s^3/A$.

5.4.7 Plural—The form of symbols and abbreviations is the same for singular or plural (1 in, 10 in, 1 s, 27 s).

5.4.8 Periods are not used after symbols or abbreviations. The same abbreviation is used for related noun, verb, adverb, etc. (inclusion, include, inclusive are all abbreviated incl). When these rules would cause confusion, spell out the word. Words of four letters or less are not abbreviated.

5.4.9 When writing a quantity, a space should be left between the numerical value and a unit symbol—for example, write 35 mm, not 35mm. An exception occurs when the symbols for degree of plane angle or degree Celsius are used, in which case the space is omitted (25°C).

5.5 Miscellaneous

5.5.1 With nominal sizes that are not measurements but are names for items, no conversion should be made: for example, 1/4–20 UNC thread, 1 in pipe, 2 x 4 lumber.

5.5.2 The decimal marker used by SAE is the dot on the line (.) for quantities in either U. S. customary or SI units.

To facilitate the reading of numbers having five or more digits, the

[9] Handling of Unit Names—Names of units are never capitalized except at the beginning of sentences or in titles. (Modifiers used in unit names are capitalized if proper names; for example, degree Fahrenheit.) Compound unit names are formed with a space for product and the word "per" for quotient. Prefixes become part of the world: ampere (A), milliampere (mA), ampere second (A·s), meter per second (m/s).

TABLE 2—ABBREVIATIONS AND SYMBOLS FOR UNITS OTHER THAN SI

Unit Name	Symbol	Abbreviation	Unit Name	Symbol	Abbreviation
brake horsepower		bhp	inch pound—force	in·lbf	
Brinell hardness number		Bhn	kilocycle	kc	
British thermal unit	Btu		kilogram—force	kgf	
calorie	cal		mile	mi	
candlepower		cp	mile per hour	mi/h	mph
cubic foot per minute	ft^3/min	cfm	minute (angle)	′	min
cubic foot per second	ft^3/s	cfs	ounce	oz	
cycle per minute	c/min	cpm	ounce—force	ozf	
cycle per second	c/s	cps	part per gallon		ppg
cycle	c		pint	pt	
degree Fahrenheit	°F		pound	lb	
degree Rankine	°R		poundal	pdl	
dram	dr		pound—force	lbf	
foot	ft		pound—force per square inch	lbf/in^2	psi
footcandle	fc		pound—force per square inch absolute		psia
foot per minute	ft/min		pound—force per square inch gage		psig
foot per second	ft/s		quart	qt	
foot pound—force	ft·lbf		revolution per minute	r/min	rpm
friction horsepower		fhp	revolution per second	r/s	rps
gallon	gal		Saybolt universal second		SUS
gallon per minute	gal/min	gpm			
gallon per second	gal/s	gps	second (angle)	″	sec
horsepower	hp		yard	yd	
inch	in				
inch of mercury	in Hg				
inch of water	in H_2O				

digits should be placed in groups of three separated by a space instead of a comma, counting both to the left and to the right of the decimal point. In the case of four digits, the spacing is optional. This style also avoids confusion caused by the use elsewhere of the comma to express the decimal marker.

For example, use:

1 532 or 1532 instead of 1,532
132 541 816 instead of 132,541,816
983 769.788 16 instead of 983,769.78816

5.5.3 Surface roughness expressed in microinches should be converted to micrometers (μm); the term "micron" shall not be used.

5.5.4 Linear dimensions on engineering drawings related to SAE committee documentation will customarily be given in millimeters regardless of length.

6. General

6.1 Mass, Force, and Weight

6.1.1 The principal departure of SI from the gravimetric system of metric engineering units is the use of explicitly distinct units for mass and force. In SI, the name kilogram is restricted to the unit of mass, and the kilogram-force (from which the suffix *force* was in practice often erroneously dropped) should not be used. In its place the SI unit of force, the newton (N) is used. Likewise, the newton rather than the kilogram-force is used to form derived units which include force, for example, pressure or stress (N/m^2 = Pa), energy (N·m = J), and power (N·m/s = W).

6.1.2 Considerable confusion exists in the use of the term *weight* as a quantity to mean either *force* or *mass*. In commercial and everyday use, the term *weight* nearly always means mass; thus, when one speaks of a person's weight, the quantity referred to is mass. This nontechnical use of the term weight in everyday life will probably persist. In science and technology, the term *weight of a body* has usually meant the force that, if applied to the body, would give it an acceleration equal to the local acceleration of free fall. The adjective "local" in the phrase "local acceleration of free fall" has usually meant a location on the surface of the earth; in this context the "local acceleration of free fall" has the symbol *g* (commonly referred to as "acceleration of gravity"). Values of *g* differing by over 0.5% at various points on the earth's surface have been observed.[10] The use of *force of gravity* (mass times acceleration of gravity) instead of *weight* with this meaning is recommended. Because of the dual use of the term weight, care should be taken to assure that the intended meaning is clear.

6.2 Many units for rates are not shown in Appendix A, but should be derived from approved units. For example, the proper unit for mass per unit time is kg/s.

6.3 Expressions that can be stated as a ratio of the same unit, such as 0.006 inch per inch, should be changed to a designation of a ratio such as 0.006:1. Where an expression might be shown in two different units one of which is a multiple of the other, reduce the expression to a common unit and show it as a ratio. Example: 1.50 in per ft = 0.125 ft per ft. Express as a ratio 0.125:1.

6.4 It has been internationally recommended that pressure units themselves should not be modified to indicate whether the pressure is *absolute* (that is, above zero) or *gage* (that is, above atmospheric pressure). If, therefore, the context leaves any doubt as to which is meant, the word *pressure* must be qualified appropriately.

For example:

". . . at a gage of 200 kPa" or
". . . at an absolute pressure of 95 kPa" or
". . . reached an absolute pressure of 95 kPa," etc.

7. Conversion Techniques—Conversion of quantities between systems of units involves careful determination of the number of significant digits to be retained. To convert "1 quart of oil" to "0.9463529 liter of oil" is, of course, nonsense because the intended accuracy of the value does not warrant expressing the conversion in this fashion.

This section provides information to be used as a guide in the conversion of quantities specified in SAE Standards. In certain circumstances, reasons may exist for using other guidance. For example, in the case of interchangeable dimensions on engineering drawings, a more specific approach is outlined in SAE J390, Dual Dimensioning, although the methods given here will usually produce the same results.

All conversions, to be logically established, *must* depend upon an intended precision of the original quantity—either implied by a specific tolerance, or by the nature of the quantity. The first step in conversion is to establish this precision.

7.1 Precision of a Value—It is absolutely necessary to determine the intended precision of a value before converting.

The intended precision of a value *should* relate to the number of significant digits shown. The implied precision is plus or minus one-half unit of the last significant digit in which the value is stated. This is true because it may be assumed to have been rounded from a greater number of digits, and one-half unit of the last significant digit retained is the limit of error resulting from rounding. For example, the number 2.14 may have been rounded from any number between 2.135 and 2.145. Whether rounded or not, a quantity should always be expressed with this implication of precision in mind. For instance, 2.14 in implies a precision of ±0.005 in, since the last significant digit is in units of 0.01 in.

Two problems interfere with this, however:

(a) Quantities *may* be expressed in digits which are not intended to be significant. The dimension 1.1875 in may be a very precise one in which the digit in the fourth place is significant, or it may in some cases be an exact decimalization of a rough dimension $1\frac{3}{16}$ in, in which case the dimension is given with too many decimal places relative to its intended precision.

(b) Quantities may be expressed omitting significant zeros. The dimension 2 in may mean "about 2 in," or it may, in fact, mean a very precise expression which should be written 2.0000 in. In the latter case, while the added zeros are not significant in establishing the value, they are very significant in expressing the proper intended precision.

[10] The value of g = 9.806 650 m/s^2 was confirmed in 1913 by the CGPM. This value will be used on earth whenever it is determined that the local differing value may be disregarded.

Therefore, it is necessary to determine an approximate implied precision before converting. This can usually be done by using knowledge of the circumstances or information on the accuracy of measuring equipment.

If accuracy of measurement is known, this will provide a convenient lower limit to the precision of the dimension, and in some cases may be the only basis for establishing it. The implied precision should never be smaller than the accuracy of measurement.

A tolerance on a dimension will give a good indication of the intended precision, although the precision will, of course, be much smaller than the tolerance. A dimension of 1.635 ± 0.003 in obviously is intended to be quite precise, and the precision implied by the number of significant digits is correct (±0.0005 in, total 0.001 in). A dimension of 4.625 ± 0.125 in is obviously a different matter. The use of thousandths of an inch to express a tolerance of 0.25 in is probably the result of decimalization of fractions, and the expression is probably better written 4.62 ± 0.12, with an implied precision of ±0.005 (total implied precision 0.01 in). The circumstances, however, should be examined and judgment applied.

A rule of thumb often helpful for determining implied precision of a toleranced value is to assume it is one-tenth of the tolerance. Since the implied precision of the converted value should be no greater than that of the original, the total tolerance should be divided by 10, converted, and the proper significant digits retained in both the converted value and converted tolerance such that total implied precision is not reduced—that is, such that the last significant digit retained is in units no larger than one-tenth the converted total tolerance.

EXAMPLE: 200 ± 15 psi. Tolerance is 30 psi, divided by 10 is 3 psi, converted is about 20.7 kPa. The value (200 psi) converted is 1 378.9514 ± 103.421 355 kPa which should be rounded to units of 10 kPa, since 10 kPa is the largest unit smaller than one-tenth the converted tolerance. The conversion should be 1380 ± 100 kPa.

EXAMPLE: 25 ± 0.1 oz of alcohol. Tolerance is 0.2 oz, one-tenth of tolerance is 0.02 oz, converted is about 0.6 cm^3. The converted value (739.34 ± 2.957 cm^3) should be rounded to units of 0.1 cm^3 and becomes 739.3 ± 3.0 cm^3.

7.2 Conversion Procedure—In the sections that follow, the "total implied precision" discussed in paragraph 7.1 is referred to as "TIP."

7.2.1 First determine TIP.

7.2.2 Convert the dimension, TIP, and the tolerance if any, by the accurate conversion factor given in this document or ANSI Z210.1.

7.2.3 Choose the smallest number of decimals to retain, such that the last digit retained is in units equal to or smaller than the converted TIP.

7.2.4 Round off to this number of decimals by the following rules:

7.2.4.1 Where the digit next beyond the last digit to be retained is less than 5, the last digit retained should not be changed. Example: 4.46325 if rounded to three places would be 4.463.

7.2.4.2 Where the digits beyond the last digit to be retained amount to more than 5 followed by zeros, the last digit retained should be increased by one. Example: 8.37652 if rounded to three places would be 8.377.

7.2.4.3 Where the digit next beyond the last digit to be retained is exactly 5, the last digit retained, if even, is unchanged; but if odd, the last digit is increased by one. Example: 4.36500 becomes 4.36 when rounded to two places. 4.35500 also becomes 4.36 when rounded.

7.2.5 Examples

7.2.5.1 Test pressure 200 ± 15 psi
TIP not evident in this case
Total tolerance 30 psi, divided by 10 is 3 psi converted equals 20.68 kPa, for TIP use 10 kPa
Units to use, 10 kPa
200 ± 15 psi equals 1 378.9514 ± 103.421 355 kPa, round to 1380 ± 100 kPa

7.2.5.2 A stirring rod 6 in long
Estimate of TIP. Assume intended precision ±1/16 in, TIP = 1/8 in
Converted TIP 1/8 × 25.4 = 3.17 mm
Units to use, 1 mm
6 in equals 152.4 mm, round to 152 mm

7.2.5.3 50 000 psi tensile strength
Estimate of TIP 400 psi from nature of use and precision of measuring equipment
Converted TIP 2.8 MPa
Units to use, 1 MPa
50 000 psi equals 344.737 85 MPa, round to 345 MPa

7.2.5.4 5.163 in length
Estimate of TIP 0.001 in (significant digits judged correct)
Converted TIP 0.0254 mm
Units to use, 0.01 mm
5.163 in equals 131.1402 mm, round to 131.14 mm

7.2.5.5 12.125 in length
Estimate of TIP 0.06 in from nature of use
Converted TIP 1.524 mm
Units to use 1 mm
12.125 in equals 307.975 mm, round to 308 mm

7.2.6 In dealing with toleranced quantities or quantities that establish limits, the rounding may be required in one direction only. When *maximum* or *minimum* are specified and judgment shows that these terms are mandatory, a maximum quantity must be rounded downward and a minimum rounded upward. The following illustrations show rounding of a dimension to two decimal places under different circumstances.

Dimension converted to 131.7625 mm
Round to two decimal places
(a) Normal dimension, untoleranced
Round to 131.76 mm (closest to original)
(b) Dimension stated as *minimum*
Round to 131.77 mm (rounded *up*)
(c) Dimension stated as *maximum*
Round to 131.76 mm (rounded *down*)

Similarly, a toleranced quantity may be rounded as in item (a). However, if critical it may be first converted to limits and each limit rounded in the appropriate fashion depending on the nature of the individual limit. For absolute maintenance of the original limits, the upper limit should be rounded down and the lower limit rounded up. (This is method B described in ANSI Z210.1.)

8. Temperature Conversion—The SI unit for thermodynamic temperature is the kelvin. The SI unit degree Celsius[11] will be used for commonly expressed temperatures.

The Celsius scale is related to the kelvin scale as follows:

One degree Celsius equals one kelvin exactly. Celsius temperature ($t_{°C}$) is related to kelvin temperature (T_K) as follows:

$$T_K = 273.15 + t_{°C}$$

The Celsius scale is related to the Fahrenheit scale as follows:

One degree Celsius equals 9/5 of a degree Fahrenheit, exactly. Celsius temperature ($t_{°C}$) is related to Fahrenheit temperature ($t_{°F}$) as follows:

$$t_{°C} = 5/9(t_{°F} - 32)$$

General guidance for converting tolerances from degrees Fahrenheit to kelvins or degrees Celsius is given below:

Conversion of Temperature Tolerance Requirements

Tolerance, °F	Tolerance, K or °C
±1	±0.5
±2	±1
±5	±3
±10	±5.5
±15	±8.5
±20	±11
±25	±14

Normally, temperatures expressed in a whole number of degrees Fahrenheit should be converted to the nearest 0.5 kelvin (or degree Celsius). As with other quantities, the number of significant digits to retain will depend upon implied accuracy of the original dimension, for example:

100 ± 5°F: implied accuracy estimated to be 2°F.
37.7777 ± 2.7777°C rounds to 38 ± 3°C.
1000 ± 50°F: implied accuracy estimated to be 20°F.
537.7777 ± 27.7777°C rounds to 540 ± 30°C.

9. Bibliography

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ANSI X3.50, Representations for U. S. Customary, SI, and Other Units to be Used in Systems with Limited Character Sets.

[11] The term "Celsius" officially replaced "Centigrade" to eliminate confusion with French metric decimalized angular measurement (a "grad" or "grade" is 1% of a right angle, and a "centigrad" or "centigrade" is 1% of a "grad").

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APPENDIX A
Application of SI Units
(including conversion factors)

The following table illustrates recommended SI use for applications in the industries served by SAE. The particular recommendations are not mandatory, but should be followed in all SAE effort unless other use conforming to SAE J916 is strongly preferred.

1. Arrangement—The unit applications are arranged in alphabetical order of quantities, by principal nouns. Thus to find SI use for Surface Tension look under Tension, Surface, and for Specific Energy look under Energy, Specific.

2. Rates and Other Derived Quantities—It is of course not practical to list all possible applications but others such as rates can be readily derived. For example, if guidance is desired for Heat Energy per Unit Volume, looking up Energy and Volume will show the recommendation kJ/m^3 (or other prefix, depending on factors discussed in paragraph 5.3).

3. Conversion Factors—Conversion factors are shown from Old Units to Metric Units to seven significant digits, unless the precision with which the factor is known does not warrant seven digits.

Exact conversion factors are indicated by *.

For conversion from Metric Units to Old Units, divide rather than multiply by the factor. For example, to convert 16.3 lb/yd^3 to kg/m^3 multiply by 0.593 276 3. The answer is 9.670 403 6 kg/m^3 which should be rounded properly according to the precision of the 16.3 lb/yd^3, probably to 9.7 kg/m^3. To convert 9.7 kg/m^3 to lb/yd^3 divide by 0.593 276 3. The answer is 16.349 886 lb/yd^3 which also should be rounded, probably to 16.3 lb/yd^3.

[12] Available in U. S. from American National Standards Institute.

TABLE A.1

Quantity	Typical Application	From Old Units	To Metric Units	Multiply by
Acceleration, angular	General	rad/s^2	rad/s^2	1*
Acceleration, linear	Vehicle	(mile/h)/s	(km/h)/s	1.609 344*
	General (includes acceleration of gravity)†	ft/s^2	m/s^2	0.304 8*
Angle, plane	Rotational calculations	r (revolution)	r (revolution)	1*
		rad	rad	1*
	Geometric and general	° (deg)	°	1*
		′ (min)	° (decimalized)	1/60*
		″ (sec)	° (decimalized)	1/3600*
Angle, solid	Illumination calculations	sr	sr	1*
Area	Cargo platforms, frontal areas, fabrics, roof and floor areas, general	in^2	m^2	0.000 645 16*
		ft^2	m^2	0.092 903 04*
	Pipe, conduit	in^2	cm^2	6.451 6*
		ft^2	m^2	0.092 903 04*
	Small areas, orifices	in^2	mm^2	645.16*
	Brake & clutch contact area, glass, radiators, agricultural	in^2	cm^2	6.451 6*
	Land and water areas (Small)	ft^2	m^2	0.092 903 04*
	(Large)	acre	ha	0.404 687 3[c]
	(Very Large)	$mile^2$	km^2	2.589 998[c]
Area per time	Field operations (agricultural)	acre/h	ha/h	0.404 687 3[c]
	Auger sweeps, silo unloader	ft^2/s	m^2/s	0.092 903 04*
Bending moment	(See Moment of force)			
Capacitance, electric	Capacitors	μF	μF	1*
Capacity, electric	Battery rating	A·h	A·h	1*
Capacity, heat	General	Btu/°F[a]	kJ/K[b]	1.899 101
Capacity, heat, specific	General	Btu/(lb·°F)[a]	kJ/(kg·K)[b]	4.186 8*
Capacity, volume	(See volume)			
Coefficient of heat transfer	General	Btu/(h·ft^2·°F)[a]	W/(m^2·K)[b]	5.678 263
Coefficient of linear expansion	Shrink fit, general	$°F^{-1}$, (1/°F)	K^{-1}, (1/K)[b]	1.8*
Conductance, electric	General	mho	S	1*
Conductance, thermal	(See Coefficient of heat transfer)			
Conductivity, electric	Material property	mho/ft	S/m	3.280 840
Conductivity, thermal	General	Btu·ft/(h·ft^2·°F)[a]	W/(m·K)[b]	1.730 735
Consumption, fuel	(See Efficiency, fuel)			
Consumption, oil	Vehicle performance testing	qt/1000 miles	L/1000 km	0.588 036 4
Consumption, specific, fuel	(See Efficiency, fuel)			
Consumption, specific, oil	Engine testing	lb/(hp·h)	g/(kW·h)	608.277 4
		lb/(hp·h)	g/MJ	168.965 9
Current, electric	General	A	A	1*
Damping coefficient		lbf·s/ft	N·s/m	14.593 90
Density, current	General	A/in^2	kA/m^2	1.550 003
		A/ft^2	A/m^2	10.763 91

For footnotes see end of Table.

† Standard acceleration of gravity 9.806 650 m/s^2 exactly.

(Table continued on next page)

TABLE A.1 (CONTINUED)

Quantity	Typical Application	From Old Units	To Metric Units	Multiply by
Density, magnetic flux	General	kilogauss	T	0.1*
Density, (mass)	Solid	lb/yd³	kg/m³	0.593 276 3
		lb/in³	kg/m³	27 679.90
		lb/ft³	kg/m³	16.018 46
		ton (short)/yd³	kg/m³	1 186.553
		ton (long)/yd³	kg/m³	1 328.939
	Liquid	lb/gal	kg/L	0.119 826 4
	Gas	lb/ft³	kg/m³	16.018 46
Density of heat flow rate	Irradiance, general	Btu/(h·ft²)[a]	W/m²	3.154 591
Diffusivity, thermal	Heat transfer	ft²/h	m²/h	0.092 903 04*
Drag	(See Force)			
Economy, fuel	(See Efficiency, fuel)			
Efficiency, fuel	Highway vehicles			
	economy	mile/gal	km/L	0.425 143 7
	consumption	—	L/100 km	**
	specific fuel consumption	lb/(hp·h)	g/MJ	168.965 9
	Off-highway equipment			
	economy	hp·h/gal	kW·h/L	0.196 993 1
	consumption	gal/h	L/h	3.785 412
	specific fuel consumption	lb/(hp·h)	g/(kW·h)	608.277 4
	specific fuel consumption	lb/(hp·h)	g/MJ	168.965 9
	Aircraft gas turbine engines			
	Thrust specific fuel consumption (Turbo-jet)	lb/(lbf·h)	kg/(kN·h)	101.971 6
	Shaft specific fuel consumption (Turbo-shaft)	lb/(hp·h)	kg/(kW·h)	0.608 277 4
Energy, work, enthalpy, quantity of heat	Impact strength	ft·lbf	J	1.355 818
	Heat[a]	Btu	kJ	1.055 056
		kcal	kJ	4.186 8*
	Electrical	kW·h	kW·h	1*
		kW·h	MJ	3.6*
	Mechanical, hydraulic, general	ft·lbf	J	1.355 818
		ft·pdl	J	0.042 140 11
		hp·h	MJ	2.684 520
Energy per area	Solar radiation	Btu/ft²[a]	MJ/m²	0.011 356 53
Energy, specific	General[a]	cal/g[d]	J/g	4.186 8*
		Btu/lb	kJ/kg	2.326*
Enthalpy	(See Energy)			
Entropy	(See Capacity, heat)			
Entropy, specific	(See Capacity, heat specific)			
Floor loading	(See Mass per area)			
Flow, heat, rate	(See Power)			
Flow, mass, rate	General	lb/min	kg/min	0.453 592 4
		lb/s	kg/s	0.453 592 4
	Dust flow	g/min	g/min	1*
Flow, volume	Air, gas, general	ft³/s	m³/s	0.028 316 85
		ft³/s	m³/min	1.699 011
	Liquid flow, pump capacity	gal/s	L/s	3.785 412
		gal/s	m³/s	0.003 785 412
		gal/min	L/min	3.785 412
	Seal and packing leakage, sprayer flow	oz/s	mL/s	29.573 53
		oz/min	mL/min	29.573 53

For footnotes see end of Table.
** Convenient conversion: 235.215 ÷ (mile/gal) = L/100 km

(Table continued on next page)

TABLE A.1 (CONTINUED)

Quantity	Typical Application	From Old Units	To Metric Units	Multiply by
Flux, luminous	Light bulbs	lm	lm	1*
Flux, magnetic	Coil rating	maxwell	Wb	0.000 000 01*
Force, thrust, drag	Pedal, spring, belt, hand lever, general	lbf ozf	N N	4.448 222 0.278 013 9
	Drawbar, breakout, rim pull, winch line pull, general[e]	lbf lbf	N kN	4.448 222 0.004 448 222
	General	pdl kgf dyne	N N N	0.138 255 0 9.806 650 0.000 01*
Force per length	Beam loading (See also Spring rate)	lbf/ft	N/m	14.593 90
Frequency	System, sound and electrical	Mc/s kc/s Hz, c/s	MHz kHz Hz	1* 1* 1*
	Mechanical events, rotational (See Velocity, rotational)			
Hardness	Conventional hardness numbers, BHN, R, etc., not affected by change to SI			
Heat	(See Energy)			
Heat capacity	(See Capacity, heat)			
Heat capacity, specific	(See Capacity, heat specific)			
Heat flow rate	(See Power)			
Heat flow, density of	(See Density of heat flow)			
Heat, specific	General[a]	cal/g[d] Btu/lb	kJ/kg kJ/kg	4.186 8* 2.326
Heat transfer coefficient	(See Coefficient of heat transfer)			
Illuminance, illumination	General	fc	lx	10.763 91
Impact strength	(See Strength, impact)			
Impedance, mechanical	(See Damping coefficient)			
Inductance, electric	Filters and chokes, permeance	H	H	1*
Intensity, luminous	Light bulbs	candlepower	cd	1*
Intensity, radiant	General	W/sr	W/sr	1*
Leakage	(See Flow, volume)			
Length	Land distances, maps, odometers	mile	km	1.609 344*[c]
	Field size, turning circle, braking distance, cargo platforms, water depth, land levelling (cut and fill)	rod yd ft	m m m	5.029 210[c] 0.914 4* 0.304 8*
	Engineering drawings, engineering part specifications, motor vehicle dimensions, general	in	mm	25.4*
	Field drainage (runoff), evaporation, irrigation depth, rain and snowfall	in	cm	2.54*
	Coating thickness, filter rating	mil µin micron	µm µm µm	25.4* 0.025 4* 1*
	Surface texture Roughness, average Roughness sampling length, waviness height and spacing	 µin in	 µm mm	 0.025 4* 25.4*
	Radiation wavelengths, optical measurements, (interference)	µin	nm	25.4*

For footnotes see end of Table.

(Table continued on next page)

TABLE A.1 (CONTINUED)

Quantity	Typical Application	From Old Units	To Metric Units	Multiply by
Load	(See Mass)			
Luminance	Brightness	footlambert	cd/m^2	3.426 259
Magnetization	Coil field strength	A/in	A/m	39.370 08
Mass	Vehicle mass (weight), axle rating, rated load, tire load, lifting capacity, tipping load, load, general	ton (long)	Mg, t	1.016 047
		ton (short)	Mg, t	0.907 184 7
		lb	kg	0.453 592 4
		slug	kg	14.593 90
	Small mass	oz	g	28.349 52
Mass per area	Fabric, surface coatings	oz/yd^2	g/m^2	33.905 75
		lb/ft^2	kg/m^2	4.822 428
		oz/ft^2	g/m^2	305.151 7
	Floor loading	lb/ft^2	kg/m^2	4.882 428
	Application rate, fertilizer, pesticide	lb/acre	kg/ha	1.120 851[c]
	Crop yield, soil erosion	ton (short)/acre	t/ha	2.241 702[c]
Mass per length	General	lb/ft	kg/m	1.488 164
		lb/yd	kg/m	0.496 054 7
Mass per time	Machine work capacity, harvesting, materials handling	ton (short)/h	t/h, Mg/h	0.907 184 7
Modulus, bulk	(See Pressure)			
Modulus of elasticity	General	lbf/in^2	MPa	0.006 894 757
Modulus of rigidity	(See Modulus of elasticity)			
Modulus, section	General	in^3	mm^3	16 387.06
		in^3	cm^3	16.387 06
Moment, bending	(See Moment of force)			
Moment of area, second	General	in^4	mm^4	416 231.4
		in^4	cm^4	41.623 14
Moment of force, torque, bending moment	General, engine torque, fasteners	lbf·in	N·m	0.112 984 8
		lbf·ft	N·m	1.355 818
		kgf·cm	N·m	0.098 066 5*
	Locks, light torque	ozf·in	mN·m	7.061 552
Moment of inertia	Flywheel, general	$lb·ft^2$	$kg·m^2$	0.042 140 11
Moment of mass	Unbalance	oz·in	kg·mm	0.720 077 8
Moment of momentum	(See Momentum, angular)			
Moment of section	(See Moment of area, second)			
Momentum	General	lb·ft/s	kg·m/s	0.138 255 0
Momentum, angular	Torsional vibration	$lb·ft^2/s$	$kg·m^2/s$	0.042 140 11
Permeability	Magnetic core properties	H/ft	H/m	3.280 840
Permeance	(See Inductance)			
Potential, electric	General	V	V	1*
Power	General, light bulbs	W	W	1*
	Air conditioning, heating	Btu/min[a]	W	17.584 27
		Btu/h[a]	W	0.293 071 1
	Engine, alternator, drawbar, power take-off, general	hp (550 ft·lbf/s)	kW	0.745 699 9
Power per area	Solar radiation	$Btu/(ft^2·h)$[a]	W/m^2	3.154 591

For footnotes see end of Table.

(Table continued on next page)

TABLE A.1 (CONTINUED)

Quantity	Typical Application	From Old Units	To Metric Units	Multiply by
Pressure	All pressure and bulk modulus	lbf/in²	kPa	6.894 757
		lbf/in² (absolute)	kPa[f]	6.894 757
		lbf/ft²	kPa	0.047 880 26
		in Hg (60°F)	kPa	3.376 85
		in H_2O (60°F)	kPa	0.248 84
		ft H_2O (60°F)	kPa	2.986 08
		mm Hg (0°C)	kPa	0.133 322
		kgf/cm²	kPa	98.066 5*
		bar	kPa	100*
		atm (standard = 760 torr)	kPa	101.325*
Pressure, sound, level	Acoustical measurements[g]	dB	dB	1*
Quantity of electricity	General	C	C	1*
Radiant intensity	(See Intensity, radiant)			
Resistance, electric	General	Ω	Ω	1*
Resistivity, electric	General	Ω·ft	Ω·m	0.304 8*
		Ω·ft	Ω·cm	30.48*
Sound pressure level	(See Pressure, sound level)			
Speed	(See Velocity)			
Spring rate, linear	General spring properties	lbf/in	N/mm	0.175 126 8
Spring rate, torsional	General	lbf·ft/deg	N·m/deg	1.355 818
Strength, field, electric	General	V/ft	V/m	3.280 840
Strength, field, magnetic	General	oersted	A/m	79.577 47
Strength, impact	Materials testing	ft·lbf	J	1.355 818
Stress	General	lbf/in²	MPa	0.006 894 757
Surface tension	(See Tension, surface)			
Temperature	General use	°F	°C	$t_{°C} = (t_{°F} - 32)/1.8$*
	Absolute temperature, thermodynamics, gas cycles	°R	K	$T_K = T_{°R}/1.8$*
Temperature interval	General use	°F	K[b]	1 K = 1°C = 1.8°F*
Tension, surface	General	lbf/in	mN/m	175 126.8
		dyne/cm	mN/m	1*
Thrust	(See Force)			
Time	General	s	s	1*
		h	h	1*
		min	min	1*
Torque	(See Moment of Force)			
Toughness, fracture	Metal properties	ksi $\sqrt{in}$	MPa·$m^{1/2}$	1.098 843
Vacuum	(See Pressure)			
Velocity, angular	(See Velocity, rotational)			
Velocity, linear	Vehicle	mile/h	km/h	1.609 344*
		knot (international)	km/h	1.851 999 8
	General	ft/s	m/s	0.304 8*
		ft/min	m/min	0.304 8*
		in/s	mm/s	25.4*
Velocity, rotational	Mechanical events (rotational) and general	rad/s	rad/s	1*
		r/s	r/s, $r \cdot s^{-1}$	1*
		r/min	r/min, $r \cdot min^{-1}$	1*
Viscosity, dynamic	General liquids	centipoise	mPa·s	1*

For footnotes see end of Table.

(Table continued on next page)

TABLE A.1 (CONTINUED)

Quantity	Typical Application	From Old Units	To Metric Units	Multiply by
Viscosity, kinematic	General liquids	centistokes	mm^2/s	1*
Volume	Truck body, shipping or freight, bucket capacity, grain bins and tanks, general	yd^3	m^3	0.764 554 9
		ft^3	m^3	0.028 316 85
		bushel	m^3	0.035 239 07
	Automobile luggage capacity	ft^3	L	28.316 85
	Gas pump displacement, air compressor, small gaseous, air reservoir	in^3	cm^3	16.387 06
	Engine displacement			
	large engines	in^3	L	0.016 387 06
	small engines	in^3	cm^3	16.387 06
	Liquid—fuel, lubricant, etc.	gal	L	3.785 412
		qt	L	0.946 352 9
		pt	L	0.473 176 5
	Small liquid	oz	mL	29.573 53
	Irrigation, reservoir	acre·ft	m^3	1 233.489[c]
			dam^3	1.233 489[c]
Volume per area	Application rate, pesticide	gal/acre	L/ha	9.353 958[c]
Weight	May mean either mass or force—see paragraph 6.1			
Work	(See Energy)			
Young's modulus	(See Modulus of elasticity)			

[a] Conversions of Btu and calorie are based on the International Table Btu and calorie.

[b] In these expressions K indicates temperature interval. Therefore K may be replaced with °C if desired without changing the value or affecting the conversion factor, for example: kJ/(kg·K) = kJ/(kg·°C).

[c] Official use in surveys and cartography involves the U. S. statute mile based on the U. S. survey foot, which is longer than the international foot by two parts per million. The factors used in this standard for acre, acre foot, U. S. statute mile, and rod are based on the U. S. survey foot. Factors for all other old length related units are based on the international foot. For detail, see ASTM E 380.

[d] Not to be confused with kcal/g. The kcal is often called "calorie" in the nutritional field.

[e] Lift capacity ratings for cranes, hoists, and related components such as rope, cables, chains, etc. should be rated in mass units. Those items such as winches, which can be used for pulling as well as lifting, shall be rated in both force and mass units.

[f] Refer to paragraph 6.4 for treatment of absolute pressure. ϕ

[g] When weighting is specified, show weighting level in parentheses following the symbol, for example: dB (A).

APPENDIX B

As covered in paragraph 5.1, SI units are required in SAE reports. To assist committees in carrying out this requirement in special circumstances, some qualifying rules are covered here.

B1. In standards that have alternative or optional procedures based on apparatus calibrated in either U. S. inch-pound or SI units, converted values need not be included. If optional procedures or dimensions produce equally acceptable results, the options may be shown by using the word *or* rather than parentheses: for example, in a 2-in gage length metal tension test specimen, the gage length may be shown as "2 in or 50 mm."

B2. A specific equivalent, for example 1.00 in (25.4 mm), need be inserted only the first time it occurs in each paragraph.

B3. Special instructions cover the use of tabular material.

Case 1. Limited Tabular Material—Provide SI equivalents in tables in parentheses or in separate columns.

ϕ STRAIGHT WHEEL GRINDERS

H	L		R
	in	mm	
3/8-24 UNF-2A	1-1/8	28.58	Governed by thickness of wheel used
1/2-13 UNC-2A	1-3/4	44.45	
5/8-11 UNC-2A	2-1/8	53.98	
5/8-11 UNC-2A	3-1/8	79.38	
3/4-10 UNC-2A	3-1/4	82.55	

Case 2. One or Two Large Tables—When the size of a table and limitations of space (on the printed page) make it impractical to expand the table to include SI equivalents, the table should be duplicated in U. S. inch-pound units and in SI units.

ϕ DIMENSIONS IN U. S. INCH-POUND UNITS

Chain No.	H60	H74	H75	H78	H82	H124
P (in)	2.308	2.609	2.609	2.609	3.075	4.000
A (in)	0.312	0.375	0.312	0.500	0.562	0.750
F (in)	0.73	1.00	0.75	1.12	1.25	1.56
H (in)	0.75	0.88	0.72	0.88	1.19	1.44
Proof test load (lbf)						
Class M	2 800	4 000	2 800	6 400	8 000	12 000
Class P	3 500	5 000	3 500	8 000	10 000	15 000
No. of pitches per nominal 120 in strand	52	46	46	46	39	30
Theoretical length of nominal 120 in strand	120.02	120.01	120.01	120.01	119.92	120.00
Measuring load (lbf)	190	270	190	130	510	810

ϕ DIMENSIONS IN SI UNITS

Chain No.	H60	H74	H75	H78	H82	H124
P (mm)	58.62	66.27	66.27	66.27	78.10	101.60
A (mm)	7.92	9.52	7.92	12.70	11.27	19.05
F (mm)	18.5	25.4	19.0	28.4	31.75	39.62
H (mm)	18.5	22.3	18.3	22.3	30.2	36.6
Proof test load (kN)						
Class M	12.50	17.80	12.50	28.50	35.60	53.40
Class P	15.60	22.20	15.60	35.60	44.50	66.80
No. of pitches per nominal 3048 mm strand	52	46	46	46	39	30
Theoretical length of nominal 3048 mm strand	3048.5	3048.2	3048.2	3048.2	3046.0	3048.0
Measuring load (N)	850	1200	850	580	2270	3600

If the above Cases 1 and 2 would still result in major increase in the size of the standard, consideration must be given to other methods. SAE

staff should first be consulted on techniques of arranging column spacing, etc., to accomplish addition of SI as shown in Cases 1 and 2.

Cases 3 and 4 are two approaches to reduce the number of pages involved in adding SI to reports with extensive tabular data. They should be used only in extreme cases since they do not accomplish the intent of SAE policy. Also, these approaches should not be considered when the users of the report are judged to need SI units for its use.

Case 3. Extensive Tabular Material—When the tabulated data is extensive and the above procedures would require an impractical addition to the standard, a summary appendix may be prepared listing all of the values appearing in the tables, along with the conversion of each, as follows:

TABLE B.1—SI EQUIVALENTS

Inches to Millimeters

in	mm	in	mm	in	mm
0.015	0.38	0.350	8.89	0.987	25.07
0.020	0.51	0.375	9.52	1.000	25.40
0.028	0.71	0.383	9.73	1.128	28.65
0.038	0.97	0.431	10.95	1.178	29.92
0.044	1.12	0.437	11.10	1.270	32.26
0.050	1.27	0.487	12.37	1.410	35.81
0.056	1.42	0.500	12.70	1.571	39.90
0.064	1.63	0.540	13.72	1.963	49.86
0.071	1.80	0.612	15.55	2.356	59.84
0.143	3.63	0.625	15.88	2.749	69.82
0.191	4.85	0.700	17.78	3.142	79.81
0.239	6.07	0.750	19.05	3.544	90.02
0.262	6.65	0.790	20.07	3.990	101.35
0.286	7.26	0.875	22.22	4.430	112.52
0.334	8.48	0.889	22.58		

Square Inches to Square Centimeters

in^2	cm^2	in^2	cm^2	in^2	cm^2
0.11	0.71	0.44	2.84	1.00	6.45
0.20	1.29	0.60	3.87	1.27	8.19
0.31	2.00	0.79	5.10	1.56	10.06

Pounds per Foot to Kilograms per Meter

lb/ft	kg/m	lb/ft	kg/m	lb/ft	kg/m
0.376	0.560	1.502	2.235	3.33	4.96
0.668	0.994	2.044	3.042	4.303	6.403
1.043	1.552	2.670	3.973	5.313	7.906

Pounds per Square Inch to Megapascals

psi	MPa	psi	MPa
50 000	345	80 000	550
60 000	415	90 000	620

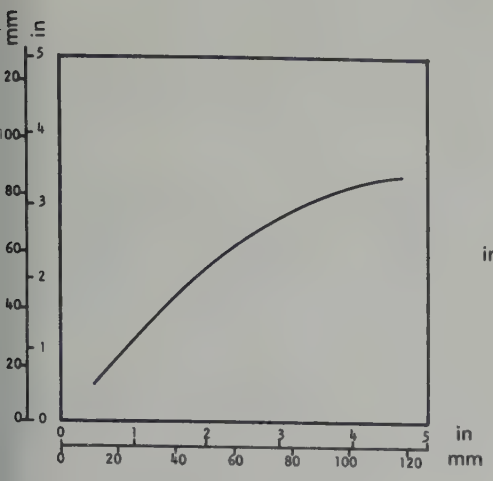
Case 4.—In extreme cases when all the above approaches do not apply because of the size and number of tables, conversion factors may be placed in a footnote under each table, as in the following example.

TABLE B.2

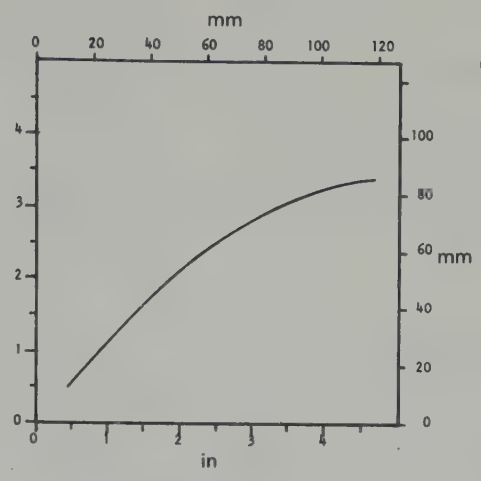
Nominal Size, in	Outside Diameter, in[a]	Wall Thickness, in[a]	Nominal Mass per ft, Plain End, lb/ft[b]	Weight Class	Schedule No.	Test Pressure,[c] psi		
						Butt-Welded	Grade A	Grade B
20	20.000	0.250	52.73	—	10	—	450	500
		0.281	59.18	—	—	—	500	600
		0.312	65.60	—	—	—	550	650
		0.344	72.21	—	—	—	600	700
		0.375	78.60	STD	20	—	700	800
		0.406	84.96	—	—	—	750	850
		0.438	91.51	—	—	—	800	900
		0.469	97.83	—	—	—	850	950
		0.500	104.13	XS	30	—	900	1000
		0.594	123.11	—	40	—	1100	1200
		0.812	166.40	—	60	—	1500	1700
		1.031	208.87	—	80	—	1900	2200
		1.281	256.10	—	100	—	2300	2700
		1.500	296.37	—	120	—	2700	2800
		1.750	341.10	—	140	—	2800	2800
		1.969	379.17	—	160	—	2800	2800
24	24.000	0.250	63.41	—	10	—	400	450
		0.281	71.18	—	—	—	400	500
		0.312	78.93	—	—	—	450	550
		0.344	86.91	—	—	—	500	600
		0.375	94.62	STD	20	—	550	650
		0.406	102.31	—	—	—	600	700
		0.438	110.22	—	—	—	650	750
		0.469	117.86	—	—	—	700	825
		0.500	125.49	XS	—	—	750	900
		0.562	140.68	—	30	—	850	1000
		0.688	171.29	—	40	—	1000	1200
		0.938	231.03	—	—	—	1400	1600
		0.969	238.85	—	60	—	1500	1700
		1.219	296.58	—	90	—	1800	2100
		1.531	367.39	—	100	—	2300	2700
		1.812	429.39	—	120	—	2700	2800
		2.062	483.12	—	140	—	2800	2800
		2.344	542.14	—	160	—	2800	2800
26	26.000	0.250	68.75	—	—	—	350	400
		0.281	77.18	—	—	—	390	450
		0.312	85.60	—	10	—	430	500
		0.344	94.26	—	—	—	480	560
		0.375	102.63	STD	—	—	520	610
		0.406	110.98	—	—	—	560	660
		0.438	119.57	—	—	—	610	710
		0.469	127.88	—	—	—	650	760
		0.500	136.17	XS	20	—	690	810
		0.562	152.68	—	—	—	780	910

[a] 1 in = 25.4 mm
[b] 1 lb/ft = 1.49 kg/m
[c] 1 psi = 6.9 kPa

B4. Graphs and charts may be handled in several ways depending on the circumstances. In adding SI units to a graphic presentation of data, the practice of specific addition of metric conversions to existing ordinate or abscissa values should be avoided.



ACCEPTABLE PRACTICE



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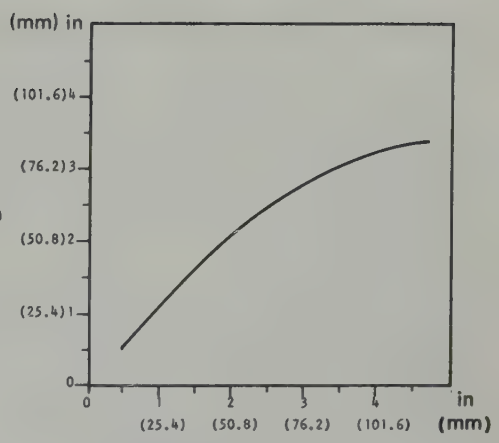


UNACCEPTABLE PRACTICE

GUIDELINES FOR DEVELOPING AND REVISING SAE NOMENCLATURE AND DEFINITIONS—SAE J1115

SAE Information Report

Report of Nomenclature Advisory Committee of SAE Automotive Council approved June 1975. Editorial change February 1976.

Introduction—Historically SAE has been concerned with nomenclature as an integral part of the standards development process. Guidelines for automotive nomenclature were written in 1916, were last revised in 1941, and were included in the SAE Handbook until 1962. The present diversity of groups working on nomenclature in the various ground vehicle committees led to the organization of the Nomenclature Advisory Committee under SAE Automotive Council.

Objective—The objective of the Committee is to promote understandable and precise communication relating to the engineering aspects of on-highway vehicles, their components, their design, and their evaluation. In order to reach this objective, the Committee is primarily concerned with the definition or redefinition of needed terms considering (a) current usage, (b) changing needs, and (c) the interactive use of a particular term by various SAE committees, government agencies, and other national and international organizations. In order to facilitate and encourage the use of generally accepted terminology by SAE committees and other organizations, the Nomenclature Advisory Committee plans to prepare and maintain a glossary of terms appearing in SAE technical reports.

Guidelines—Since the basic approach of the Committee is one of advice and coordination, the following guidelines for developing and revising SAE nomenclature and definitions are recommended:

1. Before developing and revising nomenclature, check for similar terms already defined in existing SAE Standards, Recommended Practices, and Information Reports and in Federal motor vehicle standards, in order to minimize duplication, to avoid conflict, and to achieve uniformity of format. In addition to the SAE Handbook, consult the following SAE and DOT reports:

   Vehicle Dynamics Terminology, SAE J670d
   Seating Manual, SAE J782a
   Motor Vehicle Dimensions, SAE J1100a
   Recommendations for Writing SAE Technical Reports
   49 CFR 571.3 and appropriate FMVSS

2. If dictionary definitions of common generic terms can be used, they need not be included in nomenclature listings; for example, "Acceleration."

3. Develop general definitions for general terms; for example, define

"Fully Latched" generically and not specifically as applied to doors, hoods or trunk lids. General definitions must be valid for all possible situations or contingencies, not just for the situation under immediate consideration.

4. Specific concepts or components should be identified by correspondingly specific terms when defined in a document, so that these terms can stand alone when extracted from that document and integrated with other terms in a glossary. For example, use "Tire Valve Core" rather than "Core" alone, so that the term will not be confused with another type of core, such as "Radiator Core."

5. The abbreviation for a defined term, when included, should follow it and be placed in parentheses; for example, "Decibel (dB)."

6. Terminology should follow normal word order; for example, use "Lighting Device," not "Device, Lighting," and "Brake Cylinder," not "Cylinder (Brake)." The glossary will index the defined term under each significant word in that term. For example, "Accelerator Heel Point" will appear in the index in the following permuted forms:

Accelerator Heel Point
Heel Point, Accelerator
Point, Accelerator Heel

7. Term definitions should be directed at concise statements of the items being defined, rather than at specifications, performance requirements, or test procedures. As an example, the following description includes both a definition and a test procedure:

Windshield Slope Angle—the angle between the vertical reference line and a chord of the windshield arc running from the lower DLO to the upper DLO at the car centerline, when such chord is no longer than 18.0 in. If the windshield is longer than 18.0 in, the angle to be measured will be formed by a chord 18.0 in long, drawn from the lower DLO to the intersecting point on the windshield.

8. The opposite of a term already defined within a document need not also be defined; for example, the definition of "Asymmetrical Beam" is implied by the definition of "Symmetrical Beam."

9. Nomenclature which refers to a diagram should have a sufficient written definition to make the term understandable without the diagram.

10. Explanatory or historical notes should be stated separately from and should follow the base definition and be so identified. The following example illustrates this usage:

Static Loaded Tire Radius—the loaded radius of a stationary tire inflated to normal recommended pressure.

Note. In general, the static loaded radius is different from the radius of a slowly rolling tire; and the static radius of a tire rolled into position may be different from that of a tire loaded without being rolled.

11. When two or more terms have the same definition and are used interchangeably, a preferred term should be chosen and defined. Synonymous terms may also be listed but with only a reference to the preferred item term. Example:

Barrel Gasket—the cylindrical sleeve of rubber-like material, etc.

Barrel Seal—use Barrel Gasket.

12. Definitions should be clear and useful to all who use the SAE Handbook as an engineering or technical reference.

UNIVERSAL SYMBOLS FOR OPERATOR CONTROLS—SAE J1500 JUN80

SAE Standard

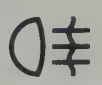
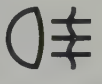
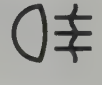
Report of the Symbols Committee of the SAE Technical Board, approved June 1980.

1. Introduction—There is an increasing use of graphic symbols throughout the world in different technical fields to communicate information and identify operation or function.

Vehicles as compared to equipment which have like functions should have like graphic symbol identification.

2. Purpose—The compilation of symbols in this document are for reference use by all current and future committees responsible for the development of symbols.

3. Scope—This standard is to delineate the symbols used to identify controls, indicators, and tell-tales for automotive vehicles, trucks, off-the-road vehicles, construction equipment, industrial and recreational transportation and is for reference purposes only. The symbol application is to be found within the appropriate standards listed.

	UPPER BEAM	LOWER BEAM	HEADLAMP CLEANER	HEADLAMP LEVELING CONTROL	FRONT FOG LIGHT	REAR FOG LIGHT	PARKING LIGHTS
ISO 2575/3 REFERENCE							
FMVSS 101/80							
CMVSS 101							
EEC 78/316							
SAE J1048 AUTOMOTIVE							
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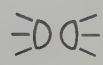
SAE J389b AGRICULTURAL							
SAE J298 INDUSTRIAL							
SAE J107 MOTORCYCLES							
SAE MARINE							
SAE SNOWMOBILES							

		MASTER LIGHTING SWITCH	TURN SIGNALS	HAZARD WARNING	SIDE LAMPS	CLEARANCE LAMPS	WINDSHIELD WIPER	WINDSHIEL WASHER
	ISO 2575/3 REFERENCE							
REGULATORY	FMVSS 101/80							
REGULATORY	CMVSS 101							
REGULATORY	EEC 78/316							
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STANDARDS	SAE TRUCKS							
STANDARDS	SAE J389b AGRICULTURAL							
STANDARDS	SAE J298 INDUSTRIAL							
STANDARDS	SAE J107 MOTORCYCLES							
STANDARDS	SAE MARINE							
STANDARDS	SAE SNOWMOBILES							
STANDARDS								

	WINDSHIELD WASHER & WIPER	WINDSCREEN DEMISTER DEFOGGER	REAR WINDOW WIPER	REAR WINDOW WASHER	REAR WINDOW WIPER & WASHER	REAR WINDOW DEMISTER DEFOGGER	VENTILATING FAN
ISO 2575/3 REFERENCE							
FMVSS 101/80							
CMVSS 101							
EEC 78/316							
SAE J1048 AUTOMOTIVE							
SAE TRUCKS							
SAE J389b AGRICULTURAL							
SAE J298 INDUSTRIAL							
SAE J107 MOTORCYCLES							
SAE MARINE							
SAE SNOWMOBILES							

		BATTERY CHARGING	ENGINE COOLANT	ENGINE OIL	FUEL	UNLEADED FUEL	CHOKE	HORN
	ISO 2575/3 REFERENCE							
REGULATORY	FMVSS 101/80							
REGULATORY	CMVSS 101							
REGULATORY	EEC 78/316							
STANDARDS	SAE J1048 AUTOMOTIVE							
STANDARDS	SAE TRUCKS							
STANDARDS	SAE J389b AGRICULTURAL							
STANDARDS	SAE J298 INDUSTRIAL							
STANDARDS	SAE J107 MOTORCYCLES							
STANDARDS	SAE MARINE							
STANDARDS	SAE SNOWMOBILES							
STANDARDS								

	LIGHTER	SEAT BELT	PARKING BRAKE	BRAKE FAILURE	FRONT HOOD (BONNET)	REAR HOOD (BOOT)	TRANSMISSION
ISO 2575/3 REFERENCE							
FMVSS 101/80							
CMVSS 101							
EEC 78/316							
SAE J1048 AUTOMOTIVE							
SAE TRUCKS							
SAE J389b AGRICULTURAL			**P**				
SAE J298 INDUSTRIAL							
SAE J107 MOTORCYCLES							
SAE MARINE							
SAE SNOWMOBILES							

		TRANSMISSION OIL PRESSURE	TRANSMISSION OIL TEMPERATURE	TRANSMISSION OIL FILTER	AIR FILTER	GREASE LUBRICANT	OIL LUBRICANT	OIL LEVEL
	ISO 2575/3 REFERENCE							
REGULATORY	**FMVSS 101/80**							
REGULATORY	**CMVSS 101**							
REGULATORY	**EEC 78/316**							
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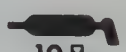
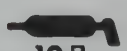
STANDARDS	**SAE** TRUCKS							
STANDARDS	**SAE J389b** AGRICULTURAL							
STANDARDS	**SAE J298** INDUSTRIAL							
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STANDARDS	**SAE** MARINE							
STANDARDS	**SAE** SNOWMOBILES							
STANDARDS								

	DIPSTICK	FIRING ORDER	ENGINE R.P.M.	FUEL SHUT-OFF	HAND BRAKE	FORWARD	REVERSE
ISO 2575/3 REFERENCE							
FMVSS 101/80							
CMVSS 101							
EEC 78/316							
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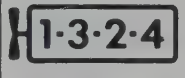
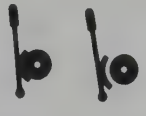
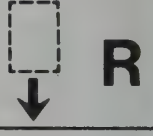
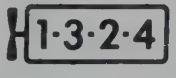
SAE TRUCKS							
SAE J389b AGRICULTURAL							
SAE J298 INDUSTRIAL							
SAE J107 MOTORCYCLES							
SAE MARINE							
SAE SNOWMOBILES							

		NEUTRAL	UP DOWN	ADD INCREASE	DECREASE	CONTROL LEVER	VOLUME LEVEL	TEMPERATUR
	ISO 2575/3 REFERENCE							
REGULATORY	FMVSS 101/80							
REGULATORY	CMVSS 101							
REGULATORY	EEC 78/316							
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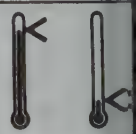
STANDARDS	SAE J389b AGRICULTURAL	N		+	—			
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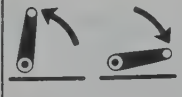
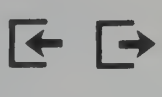
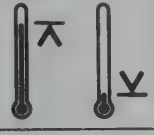
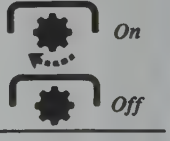
STANDARDS	SAE J107 MOTORCYCLES							
STANDARDS	SAE MARINE							
STANDARDS	SAE SNOWMOBILES							
STANDARDS								

	TEMPERATURE CONTROL	DIFFERENTIAL LOCK	ROCK SHAFT	CONNECTION	AXLE DISCONNECT	TOW	POWER TAKE-OFF
ISO 2575/3 REFERENCE							
FMVSS 101/80							
CMVSS 101							
EEC 78/316							
SAE J1048 AUTOMOTIVE							
SAE TRUCKS							
SAE J389b AGRICULTURAL							
SAE J298 INDUSTRIAL			*Raised Lowered*	*Engage Disengage*	*Connect Disconnect*		 *On Off*
SAE J107 MOTORCYCLES							
SAE MARINE							
SAE SNOWMOBILES							

		REMOTE CYLINDER	HEAVY LIGHT	BACKHOE DIPPERSTICK CONTROL	BACKHOE BOOM CONTROL	BACKHOE SWING CONTROL	BACKHOE BUCKET CONTROL	LOADER LIFT ARM CONTROL
	ISO 2575/3 REFERENCE							
REGULATORY	**FMVSS 101/80**							
REGULATORY	**CMVSS 101**							
REGULATORY	**EEC 78/316**							
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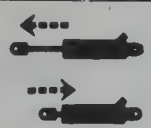
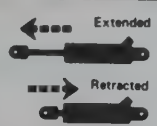
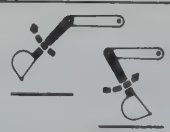
STANDARDS	**SAE** TRUCKS							
STANDARDS	**SAE J389b** AGRICULTURAL							
STANDARDS	**SAE J298** INDUSTRIAL							
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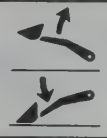
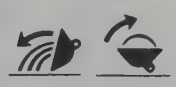
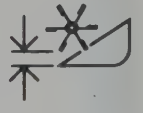
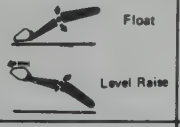
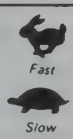
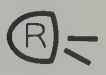
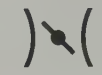
STANDARDS	**SAE** MARINE							
STANDARDS	**SAE** SNOWMOBILES							
STANDARDS								

	LOADER BOOM CONTROL	LOADER BUCKET CONTROL	STABILIZER CONTROL	UNLOADING AUGER	HEADER	REEL SPEED	REEL HEIGHT
ISO 2575/3 REFERENCE							
FMVSS 101/80							
CMVSS 101							
EEC 78/316							
SAE J1048 AUTOMOTIVE							
SAE TRUCKS							
SAE J389b AGRICULTURAL							
SAE J298 INDUSTRIAL							
SAE J107 MOTORCYCLES							
SAE MARINE							
SAE SNOWMOBILES							

		PLATFORM HEIGHT	CYLINDER SPEED (COMBINE)	CONCAVE CLEARANCE (COMBINE)	GROUND SPEED	SPEED RANGE	ALL MECHANISMS	PRESSURIZE OPEN SLOWLY
	ISO 2575/3 REFERENCE							
REGULATORY	**FMVSS 101/80**							
REGULATORY	**CMVSS 101**							
REGULATORY	**EEC 78/316**							
STANDARDS	**SAE J1048** AUTOMOTIVE							
STANDARDS	**SAE** TRUCKS							
STANDARDS	**SAE J389b** AGRICULTURAL							
STANDARDS	**SAE J298** INDUSTRIAL							
STANDARDS	**SAE J107** MOTORCYCLES							
STANDARDS	**SAE** MARINE							
STANDARDS	**SAE** SNOWMOBILES							
STANDARDS								

	BASKET LIFT	HOURS	READ OPERATOR'S MANUAL	REVERSING LAMP	HAND ACCELERATOR THROTTLE	DIESEL ENGINE CUT-OFF	
ISO 2575/3 REFERENCE							
FMVSS 101/80							
CMVSS 101							
EEC 78/316							
SAE J1048 AUTOMOTIVE							
SAE TRUCKS							
SAE J389b AGRICULTURAL							
SAE J298 INDUSTRIAL							
SAE J107 MOTORCYCLES							
SAE MARINE							
SAE SNOWMOBILES							

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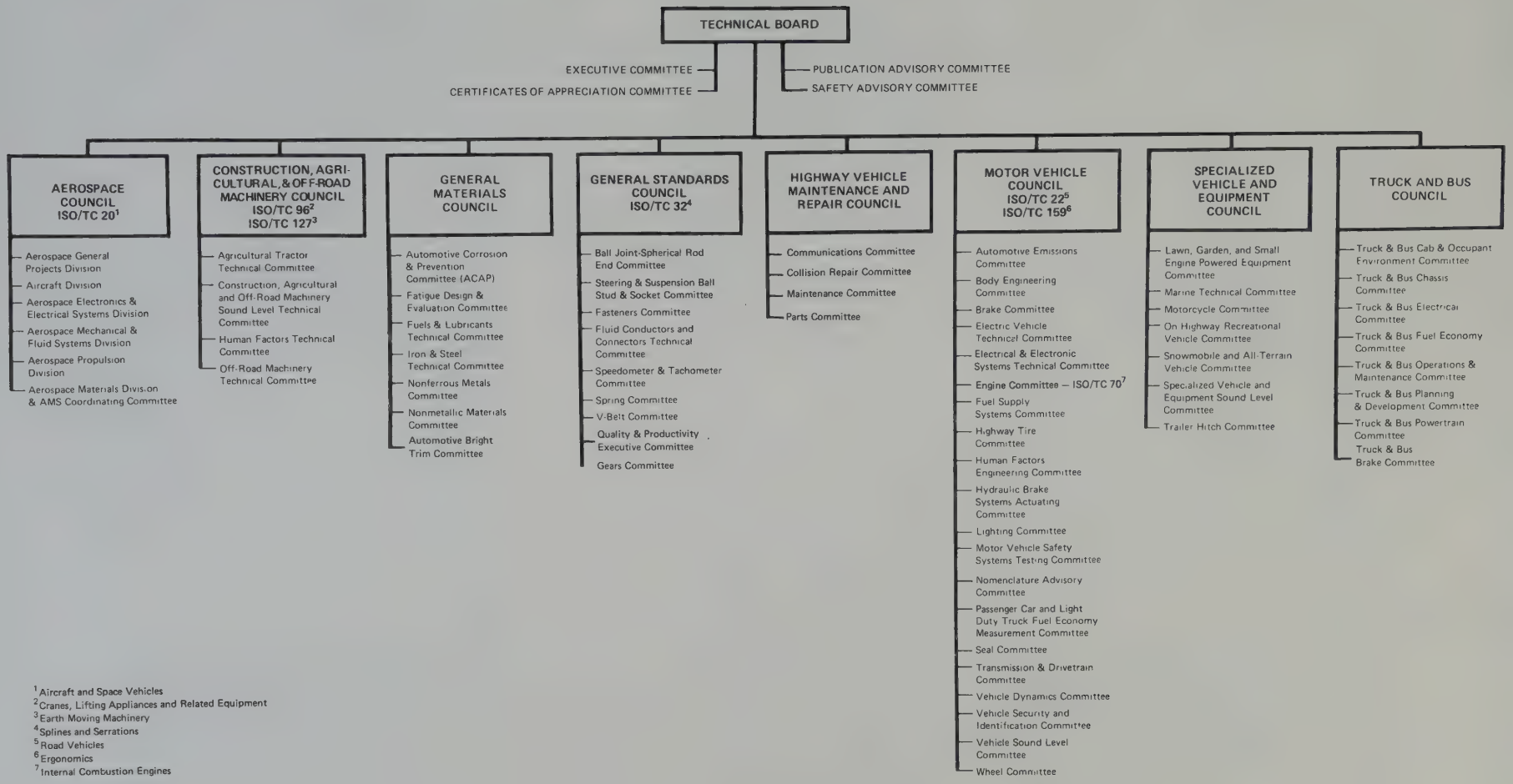
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Aircraft Division
Aerospace Electronics & Electrical Systems Division
Aerospace Mechanical & Fluid Systems Division
Aerospace Propulsion Division
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Vehicle Sound Level Committee
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On Highway Recreational Vehicle Committee
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Truck & Bus Chassis Committee
Truck & Bus Electrical Committee
Truck & Bus Fuel Economy Committee
Truck & Bus Operations & Maintenance Committee
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[1] Aircraft and Space Vehicles
[2] Cranes, Lifting Appliances and Related Equipment
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[4] Splines and Serrations
[5] Road Vehicles
[6] Ergonomics
[7] Internal Combustion Engines

September 1984

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L. E. KISELIS
Ford Motor Co., Chassis Engrg.
D. D. MACINTYRE
Kelsey-Hayes Co., Engineering

PASSENGER CAR WHEEL SUBCOMMITTEE– D. D. MACINTYRE (Chairman), Kelsey-Hayes Co., Engineering; J. R. AURELIA, General Motors Corp., Chevrolet Engrg. Center; R. BROWN, Superior Industries Int'l Inc.; A. R. DIXEY, GKN North America, Inc., GKN Universal Transmissions GmbH; G. GIOVANNONE, American Motors Corp.; G. L. GOODENOW, General Motors Corp., General Motors Proving Ground; R. H. HELLMANN; A. HOFSTETTER, Cragar Indstries, Inc.; R. C. HOLMSTROM, Rockwell Int'l, Western Wheel Div.; H. S. KARZUN, Ford Motor Co., Truck Operations; J. R. KINSTLER, Goodyear Tire & Rubber Co., Motor Wheel Corp.; L. E. KISELIS, Ford Motor Co., Chassis Engrg.; A. S. KUHNS, Appliance Ind.; W. C. LONG; L. R. MALWITZ, Appliance Ind.; R. MUELLENS, N.I., Inc.; D. J. ORBAN, Chrysler Corp.

TRUCK WHEEL SUBCOMMITTEE– R. G. SCHAEFER, Int'l Harvester Co., Truck Design Center

SAE REPRESENTATION IN OTHER TECHNICAL ORGANIZATIONS

COORDINATING RESEARCH COUNCIL, INC.

SAE and the American Petroleum Institute jointly organized the Coordinating Research Council, Inc. in 1942. The object of the CRC is to encourage and promote the arts and sciences by directing scientific cooperative research in developing the best combinations of fuels, lubricants, and equipment powered by internal combustion engines; and to afford means of cooperation with the government on matters of national interest within this field.

In the course of research sponsored by the three technical committees of the Council (the Air Pollution Research Advisory Committee, the Coordinating Fuel and Equipment Research Committee, and the Coordinating Lubricants and Equipment Research Committee), a number of research techniques have been developed. Those considered suitable for standardization have been referred to the American Society for Testing and Materials.

Information on the work of the technical committees may be secured from the Coordinating Research Council, Inc., 219 Perimeter Center Parkway, Atlanta, GA 30346.

TRANSPORTATION RESEARCH COUNCIL

R. S. Shackson (W. M. Spreitzer, Alt.)

U. S. NATIONAL COMMITTEE OF THE INTERNATIONAL COMMISSION ON ILLUMINATION

D. M. Finch, G. E. Meese, P. W. Maurer

U. S. TECHNICAL COMMITTEE TO INTERNATIONAL (CIE) COMMITTEE 4.8, AIRBORNE LIGHTING

(SAE COMMITTEE A-20, AIRCRAFT LIGHTING)
Paul H. Greenlee

COMMITTEE ON COLORS OF SIGNAL LIGHTS
(D. M. Finch, Alt.)

SAE TECHNICAL BOARD RULES AND REGULATIONS

1. PURPOSE: These Rules and Regulations (the "Rules") govern the operation of the Technical Board, Councils and Technical Committees.

2. TECHNICAL BOARD: The Technical Board (the "Board") is responsible to the SAE Board of Directors.

2.1 Scope: It is the duty of the Board to promote and supervise technical committee activities of SAE, including participation in technical committees of other organizations and to approve and issue technical reports including standards, recommended practices, and information reports (hereinafter collectively referred to as "Technical Reports") resulting from its activities.

3. RESPONSIBILITIES AND QUALIFICATIONS OF MEMBERS OF THE TECHNICAL BOARD, COUNCILS AND COMMITTEES: In discharging their responsibilities, members of the Technical Board, Councils and Committees function as individuals and not as agents or representatives of any organization with which they may be associated, except that governmental employees participate in accordance with government regulations. Members are appointed to SAE Technical Committees on the basis of their individual qualifications which enable them to contribute to the work of the Committees. Members of the Technical Board shall be voting members of SAE. SAE membership is not a prerequisite for membership on Councils or Technical Committees of the Technical Board.

4. ORGANIZATION OF TECHNICAL BOARD: The Technical Board shall comprise twenty-four voting members of SAE. The Councils and Technical Committees shall be responsible to the Technical Board. Those Councils existing at the time of adoption of these rules shall comprise the initial Councils.

4.1 Chairperson of the Board: The Chairperson is appointed in accordance with the SAE Bylaws.

4.2 Secretary: The Secretary of the Board and any assistants thereto shall be designated by the Executive Vice-President of SAE.

4.2.1 The Secretary shall be responsible for recording and distributing minutes of meetings of the Board and such other functions as may be directed by the Board or its Executive Committee from time to time.

4.2.2 The Secretary shall have sole authority to release information and publicity with respect to the work of the Board and its committees, unless the Board specifically directs otherwise.

4.3 Executive and Administrative Committees of the Technical Board

4.3.1 Executive Committee: At the Board's first meeting in each administrative year, the Chairperson, with the approval of the Board, shall appoint an Executive Committee from the membership of the Board to serve for one year. The Chairperson of the Board shall be the Chairperson of the Executive Committee.

4.3.2 Duties and Responsibilities: The Executive Committee shall be responsible for the executive and administrative functions of the Board, and, on matters requiring prompt disposition which arise between meetings of the Board, shall exercise all powers of the Board, except for approval of Technical Reports. The Executive Committee shall notify the Board of all such action taken. All actions of the Executive Committee shall be subject to review and confirmation by the Board. The Executive Committee may meet by means of telephone conference when it is impractical to meet in person. As needed, the Executive Committee will form an Appeals Panel in accordance with Section 9.

4.3.3 Appointment of Administrative Committees: The Board may appoint such administrative committees as are necessary to carry on its work.

4.4 Technical Board Meetings

4.4.1 Only members of the Board may attend and vote at Board meetings. Other persons may attend at the invitation of the Board Chairperson.

4.4.2 The Chairperson of the Board shall preside at meetings of the Board and, if not present, a member of the Executive Committee designated by the Chairperson or by that Committee shall preside.

4.4.3 No meeting shall be conducted where an agenda has not been sent to the Board Members at least five days before its scheduled date. No action by the Board shall take place at such meeting on items not on the meeting agenda. Minutes shall be taken of each meeting.

4.4.4 One-half of the members of the Board shall constitute a quorum. If there is not a quorum, the business of the meeting can be conducted, but the actions taken shall not become Board action until approved by letter ballot of the Board members.

4.4.5 Action by the Board shall be by majority vote of those present at which there is a quorum, except as to Technical Reports submitted to it for approval which approval is governed by paragraph 8.5.

4.4.6 Matters referred by the Board for letter ballot shall require approval by a majority of the ballots sent, except as to Technical Reports.

4.4.7 Questions of parliamentary procedure shall be determined by Roberts Rules of Order, latest edition.

4.5 Election to the Annual Nominating Committee: At the Board's first meeting of the administrative year, the Executive Committee will submit for the election by the Board, recommendations for one delegate and two alternates to serve on the SAE's Annual Nominating Committee. All delegates and alternates shall be voting members of SAE, but need not be members of the Board. These names must be submitted to the Secretary of the SAE no later than September 30.

4.6 Election of Technical Board Nominating Committee: At the Board's first meeting of the administrative year, the Board shall elect from its membership seven members to serve as a Nominating Committee to nominate a voting member of the SAE to serve as a Director on SAE's Board of Directors. The first member elected to the Nominating Committee shall serve as Temporary Chairperson and shall assume the responsibility of calling the first meeting of the Committee. A quorum shall consist of five members and a nomination made by the Committee shall be approved by at least four of these members. It shall be the duty of this Nominating Committee to submit to the SAE's Secretary, no later than June 15, each year, the name of a consenting nominee to serve as a Director for a term of three years. This nominee shall be listed on the ballot for election of Officers submitted to the voting members.

4.7 Authority to Organize Councils: The Board may organize additional Councils or discontinue any existing Councils.

5. COUNCILS

5.1 Responsibilities: Each Council shall have the authority to initiate, develop, revise or repeal SAE Technical Reports within its defined scope of activity. Each Council shall comply with these Rules and shall assure conformance of each SAE Technical Report to the requirements of these Rules.

5.2 Membership and Chairpersons: The Board shall appoint the membership and chairperson of each Council. Thereafter, before the end of each year, each Council shall nominate a chairperson for approval by the Board. Members shall meet the qualifications in Section 3.

5.2.1 Each Council shall have membership of not less than seven members nor more than twenty-five members. Members of any administrative committee or Division appointed by a Council shall not be included in such number.

5.2.2 Members of a council shall be appointed for three-year terms by the Board, except for the initial appointments where one-third of the members shall be appointed for one, two, and three year terms, respectively.

5.2.3 If a member is unable to complete a term on a Council, the chairperson may appoint a replacement to complete the unexpired term.

5.3 Vice-Chairperson: A Council may annually elect a vice chairperson to preside at any Council meeting in the absence of the chairperson.

5.4 Secretary: The Secretary of the Council shall be designated by the Manager of the Technical Division of SAE. The Secretary shall be responsible for the performance of such staff functions as the Council may direct, and shall provide for recording and distribution of the agenda for and minutes of all Council and Technical Committee meetings.

5.5 Council Meetings: There shall be at least one meeting of each Council each year. All meetings will be at the call of the chairperson who shall preside, and shall be conducted in the manner set forth for the Board.

5.6 Authority to Organize Technical Committees: Each Council shall organize Technical Committees or Divisions to develop, review, revise or repeal Technical Reports within its defined scope of activity. The Council shall define the scope of each committee. A Technical Committee should be established to initiate the development of a new Technical Report when no existing committee has the required expertise and balance and there is evidence of the need for such a committee.

6. TECHNICAL COMMITTEES

6.1 Responsibility: The Technical Committees are to develop, review, maintain and repeal Technical Reports within their defined areas of activity.

6.2 Committee Membership: A person is nominated for member-

ship in an SAE Technical Committee by the Technical Committee chairperson. The responsible Council, subject to disapproval by the Board, shall appoint members to the Technical Committee from those nominated as well as any other persons who have submitted their names to the Council. Appointments shall be based on the individual's ability to contribute to the work of the committee. SAE membership is not a prerequisite to membership on a Technical Committee. Only members of the committee may vote on a matter coming before the committee.

6.3 Committee Composition: Overall Technical Committee membership shall attempt to attain an equitable balance of representation by knowledgeable persons at interest so as to provide a competent and authoritative committee. In considering the equitable balance of a committee, the individual's point of view as a producer, user, consumer or regulator shall be considered.

6.4 Participation: A person not a member of a committee may participate in Technical Committee activities and deliberations. Any person who is or may be directly and materially affected by any proposed committee activity may request to participate by writing to the responsible Council and by identifying in such request the interest which may be affected and the individual's qualifications. In selecting those who wish to participate an attempt shall be made to attain equitable balance and no single interest shall dominate. Observer status may be granted to persons who do not wish to participate or who are not directly or materially affected by the activity.

6.5 Officers: Each Technical Committee shall have a chairperson and may have a vice-chairperson and a secretary. The chairperson and vice-chairperson shall be appointed by the Council chairperson with consent of the Council members. Council shall endeavor to obtain frequent rotation of chairpersons.

6.5.1 Official Reporter: Prior to the development of or a revision to a Technical Report, the Committee or working group shall appoint at least one Reporter to write or revise such Report. Such Reporter shall be responsible for preparing all drafts of the Report including the final Technical Report and shall be charged with making all changes to the draft necessary to accommodate the views of the Committee or group or to achieve a consensus. Before commencing the writing of the Report, each person acting as the Reporter shall sign a Copyright Agreement acknowledging that the Report is a work made for hire pursuant to the Copyright Act or, if not so defined, transferring the copyright in the Report to SAE.

6.5.1.1 The Technical Report may identify by name the Official Reporter if such person so desires.

6.5.1.2 No Technical Report shall be accepted for publication unless a Copyright Agreement has been signed by each person acting as an Official Reporter.

6.6 SAE Staff Representative: An SAE staff representative shall be assigned to each Technical Committee and working group to advise and assist such Committee on procedures, organization and operation. The SAE staff representative shall have authority to suspend any committee or group activity which is undertaken in or carried out in contravention of these Rules or any laws or order. The suspended activity may only be commenced upon affirmative vote of the responsible Council.

6.7 Subordinate Committee Structure: Working groups such as subcommittees, task forces, ad hoc committees, panels or other groups may be organized under a Technical Committee with membership having specific specialized expertise for the purpose of drafting proposed Technical Reports. Such groups should be balanced in accordance with the requirements specified in paragraph 6.3, however, the fact that such group does not achieve balance shall not affect the status of the proposal. Such groups may be specifically organized to develop recommendations for standards for military use or for use by other governmental agencies. The work of all such subordinate committee groups shall be subject to review and approval by the parent committee.

6.8 Committee Meetings: Meetings of Technical Committees or Groups shall, be conducted in the manner set forth for the Board, except that actions as to Technical Reports shall be governed by Section 8. Participants or observers shall not be included in the number necessary for a quorum, but views of each such participant shall be considered and all objections shall be sought to be resolved as set forth in Section 7. All meetings shall be open, but the chairperson shall have discretion as to the number of persons not members, participants or observers who may be permitted to attend or speak.

6.9 Initiation of Projects: Subject to Council approval and paragraph 7.2, a Technical Committee may initiate a project within its defined scope and which lends itself to a technical solution.

6.10 Termination of Committees: A Technical Committee or group may be discharged by its Council when the assigned work is completed and responsibility for reviewing its published Technical Reports is delegated to another Technical Committee.

7. TECHNICAL REPORTS

7.1 General Considerations: Technical reports are to be limited to technical and engineering considerations. They are to be written in accordance with the SAE TECHNICAL REPORT GUIDELINES. The existence of other standards or recommended practices including ISO standards directly relating to the subject matter of the technical report shall be considered.

7.2 Public Notice: Whenever a Council authorizes a Technical Committee to initiate, revise or consider repeal of Technical Report(s), notice of such authorization shall be published in *Automotive Engineering* and/or *Aerospace Engineering*. Such notice shall identify the subject matter of the Technical Report(s) and the proposed date of the first committee meeting which shall not be sooner than thirty (30) days following publication of the notice. The Council may also provide notice to any others it believes may be directly and materially affected by the proposed activity.

7.3 Classification of Technical Reports

7.3.1 SAE Standards: These technical reports are a documentation of broadly accepted engineering practices or specifications for a material, product, process, procedure, or test method.

7.3.2 SAE Recommended Practices: These reports are documentations of practice, procedures and technology that are intended as guides to standard engineering practice. Their content may be of a more general nature, or they may propound data that have not yet gained broad acceptance.

7.3.2.1 The recommended practice should emphasize the capabilities and limitations of the information contained therein.

7.3.2.2 A technical committee preparing such a report may add an introductory note stating, "This SAE Recommended Practice is intended as a guide toward standard practice and is subject to change to keep pace with experience and technical advances."

7.3.3 SAE Information Reports: These reports are compilations of engineering reference data or educational material useful to the technical community.

7.3.4 Aerospace Material Specifications: These identify material and process specifications conforming to sound, established engineering and metallurgical practices in aerospace sciences and practices.

7.4 Test Procedures: Technical committees are encouraged to develop test procedures where appropriate and necessary to a meaningful Technical Report.

7.5 Performance Levels

7.5.1 The Board and Councils are responsible for developing specific policies concerning the advisability of the committees developing performance levels for specific procedures or subject areas. Such policies will direct development of performance levels for Technical Reports involving dimensional requirements or grade, class or type identification and differentiation. When Technical Reports concern major systems or complete machines or vehicles, the necessity and desirability of developing performance levels are to be directed and accepted by the appropriate Council before development work is commenced by a Technical Committee.

7.5.2 If a Council concludes that performance levels are appropriate, the rationale used by the committee or group in selecting the applicability and limits must be clearly defined for consideration by and submitted for approval by its Council. The Technical Committee's rationale shall include information giving reasons for identified differences between the submitted Technical Report and other existing standards or regulations. Levels which exceed the state-of-the-art are to be avoided.

7.6 Patents and Copyrights: In developing a Technical Report, Technical Committees are not to consider whether the subject matter set forth is patented. However, if the committee is aware of any copyrights applicable to published material then such material shall not be used in the Technical Report. In the event it is known by the committee that following the practice of a Technical Report will probably result in the infringement of a patent, the committee shall set forth criteria which will permit the user to conform to the technical report without infringing such patent. No proprietary names or trademarks shall be used in Technical Reports without written permission of the owner together with a generic description of the product sufficient to enable a user to conform to the Technical Report without resort to such proprietary product.

7.7 Notice on all Technical Reports: Every approved Technical Report shall carry the following statements: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and

suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

7.8 Review: Each Technical Report shall be reviewed at least every five years. During such reviews, initiated by the SAE staff representative, the Technical Report may be reaffirmed, revised, or cancelled. If reaffirmed, no formal ballot of the responsible Council is needed, but the Council should be informed of the action. Regular balloting by the Council is required for a revision or cancellation.

7.9 Product Reference to Technical Reports: Use of "SAE" together with a Technical Report number or report identifier or marking on or in reference to a product shall constitute a certification by the person so using the SAE number, identifier or marking that the product to which it is applied or referred conforms in all respects to the specifications or criteria of the report or use of marking.

8. APPROVAL OF TECHNICAL REPORTS

8.1 Ballot Approval by Technical Board, Its Councils and Their Technical Committees: Where full agreement cannot be achieved, Technical Reports shall have the approval of at least three-fourths of the responding committee members, provided at least one-half of all members receiving a ballot respond and have not waived their vote.

8.2 Definitions

8.2.1 Substantial agreement means much more than simple majority, but not necessarily unanimity.

8.2.2 Consensus means existence of a substantial agreement, but not less than three-fourths of responding ballots in accordance with paragraph 8.1, and that an objective effort has been made to obtain a mutually satisfactory resolution of all dissenting viewpoints.

8.2.3 Full agreement means that all dissenting or objecting viewpoints have been considered and resolved to the mutual satisfaction of the members and participants.

8.3 Policy

8.3.1 Basis for Approval: The Councils are authorized to approve Technical Reports, except when an appeal is filed as provided in Section 9. For each Technical Report, Technical Committees and Councils shall strive for full agreement among its members and in no case shall a Technical Report be approved which does not have a consensus. All letter ballots shall be considered responsive if received by the responsible SAE staff representative within four weeks of their having been sent to the member or participant.

8.3.2 Appeals: Any person (whether or not a member, participant or observer) having a procedural complaint or substantive disapproval or whose dissenting view on a Technical Report remains unresolved shall have the right to appeal to the Technical Committee from a subcommittee or to the Council from a Technical Committee. An appeal from the action or refusal to act of the Council shall be in accordance with Section 9.

8.3.3 Changes to Technical Content: Neither the Councils nor the Board shall alter the technical content of a Technical Report.

8.4 Approval by the Technical Committee(s): Approval by the involved Technical Committee(s) constitutes a recommendation to the Council(s) to approve the Technical Report.

8.4.1 Voting Procedure, Tally, and Reporting: Technical committees voting on technical reports shall be conducted by letter ballot sent to the members and participants not less than two or more than four weeks prior to the vote. Comments and/or approval from participants and others substantially affected should be obtained. Ballots shall be distributed to Technical Committee members and participants and returned ballots of members tallied by the SAE staff representative who shall report the outcome of the voting to the chairperson and other committee members and participants and any other substantially affected persons having submitted a ballot or comments.

8.4.2 Review of the Ballot: A summary of the ballot, including all negative ballots and comments, shall be reviewed by the Technical Committee chairperson and SAE staff. They shall review the summary and advise the committee members and participants of any negative votes or dissenting views and any proposals to resolve the negative vote or dissenting views. The Technical Committee chairperson shall decide whether or not the proposed changes shall be reballoted by the Technical Committee(s) or a meeting called.

8.4.3 Recommendation to the Council(s): The committee chairperson shall prepare the information for transmittal to the Council(s). The rationale for any performance requirements shall accompany the ballot as required by paragraph 7.5.2. All unresolved dissenting views shall accompany the Technical Report when submitted to the Council(s). The committee's reasons for not accepting the dissenting views shall be included.

8.5 Approval by Council

8.5.1 Council Review: Council members will review Technical Reports for SAE policy implications and for impact of the Technical Reports on users, the public and other interested parties. Council will also consider the Technical Committee's record of voting and the consensus obtained from all participants.

8.5.2 Negative Ballots: Receipt of a written negative ballot with supporting rationale within four weeks after the circulation of a Technical Report requires the proposal to be reconsidered by Council before final action. Prior to reconsideration, negative ballots and comments shall be referred to the Technical Committee for resolutions. If there is mutually satisfactory resolution, the draft Technical Report together with the reasons for the negative ballot and the committee's reply to the negative ballot shall be resubmitted to the Council by letter ballot.

8.5.3 Council Action: A Council will approve the Technical Report, disapprove the Technical Report, or refer the Technical Report with any dissenting views to the Board for action. A summary of the council ballots and actions taken by the Technical Committee shall be organized by the SAE staff representative and forwarded to the Council chairperson.

8.6 Approval by Technical Board: Technical Reports referred to the Board by a Council or those with unresolved dissenting views shall be approved or disapproved by letter ballot. The chairperson of the Board shall declare the Technical Report approved only when no appeal has been taken, and a consensus exists in the committee and Council.

9. APPEAL

9.1 Appeals Panel: The Executive Committee of the Board shall form an Appeals Panel to hear all appeals from any action or refusal to act by any Council or committee of the Board. The Board chairperson and immediate past-chairperson, respectively, of the Board shall act as the chairperson and vice-chairperson, respectively, of such Appeals Panel and the Appeals Panel shall include at least the chairperson or vice-chairperson and two additional members selected from the Executive Committee.

9.2 An appeal shall be commenced by filing with the chairperson a written notice within twenty (20) days from the date of action or refusal to act, or, in the case where such person appealing was not present at meeting taking such action, or refusing to act, then twenty (20) days from the date notice of such action was available to the public or made known to appellant.

9.3 Failure to appeal (paragraph 8.3.2) from a committee action or refusal to act shall not preclude an appeal from any action of a Council affirming the action or refusal to act of such Technical Committee if taken within the time set out in paragraph 9.2, provided, however, there shall be no right to appeal any action or refusal to act by any Technical Committee, Council or the Board acting in compliance with an unappealed mandate of the Appeals Panel or the unreversed mandate of the Appeals Panel.

9.4 Within thirty (30) days of filing the notice of appeal, the person appealing shall file with the chairperson of the Panel all information, data and materials relied upon in support of the appeal, together with an identification of all persons such appellant intends to have present testimony at a hearing. Failure to file such items will result in a dismissal of such appeal with prejudice.

9.5 The chairperson may invite such other persons to present testimony or evidence as the chairperson deems necessary for a fair presentation of the facts. A list of all such persons invited or requesting to present evidence in such matter shall be sent to the appellant at least fifteen (15) days prior to the hearing.

9.6 The chairperson of such Appeals Panel shall establish the time and location during the week and the place of the next regularly established Operating Board or Standing Committee or SAE Board of Directors' meeting, to hear such appeal, provided the notice of appeal was filed more than ninety (90) days prior to such meeting. In the case such notice of appeal was filed within ninety (90) days or the parties of the appeal request a later date, the hearing shall be held at the next, subsequent regular scheduled meeting of the Operating Board or Standing Committee or Board of Directors. The chairperson may, at the request of any party to the appeal, schedule such hearing any time or place convenient to the parties and the Appeals Panel.

9.7 The chairperson shall conduct the hearing, making all rulings regarding the order and presentation of testimony and evidence including adjourning or continuing such hearing. Failure of appellant to appear at such hearing shall constitute a withdrawal of the appeal.

9.8 Within ninety (90) days of the close of the hearing, the Appeals Panel shall render a decision which shall be in writing and sent to appellant and any other interested persons appearing at such hearing and

the chairperson of any subcommittee, technical committee or council whose action or refusal to act was the subject of such appeal. Such decision shall include all reasons therefor.

10. RECORDS: The records of the Board, its Councils and its committees, shall be maintained for a reasonable time in the offices of the SAE where they will be available for inspection by members of the SAE and the public, except as the Board or the staff security officer (in the case of classified material) directs otherwise. All documents which provide a basis for a Technical Report, including minutes, shall be maintained by SAE for a period of five years. Such documents shall be in sufficient detail so as to enable one to understand what transpired in the development, revision or repeal of Technical Report, except that the individual ballots shall not be maintained.

11. CORRESPONDENCE: Copies of committee correspondence should be sent to the chairperson and SAE staff representative. Members shall use correspondence forms which are available, upon request, from the SAE staff representative. Members shall not use stationery with a company or business letterhead.

12. INTERPRETATIONS OF TECHNICAL REPORTS: No member or participant of a Technical Committee, Council or Board or SAE staff representative shall make any interpretation of a Technical Report in the name of SAE. A request for interpretation or clarification of a Technical Report shall be made in writing to the Secretary of the Board who will review the request and, if determined to be appropriate for further review, promptly forward it to the Chairperson of the Technical Committee that prepared the Report. If the Chairperson determines that the Report requires clarification, then the Technical Committee shall initiate a revision of the Report in accordance with paragraphs 6.9 and 7.2. The requestor shall be notified of the decision to revise such Report. If either the Chairperson or Secretary determines that no clarification or further review is required, the Secretary shall notify the requestor of such determination in writing.

13. AMENDMENTS: Amendments to these Rules and Regulations and the SAE Technical Report Guidelines shall be approved by letter ballot by not less than three-quarters of the members of the Board, subject to final approval by the Directors.

Adopted January 10, 1946
Revised January 14, 1972
Revised October 20, 1976
Revised June 8, 1977
Revised May 25, 1978
Revised December 1, 1982
Revised November 30, 1983

REFEREE MATERIALS

The materials listed below are available from SAE for use in testing a variety of products for compliance with SAE documents. Where those materials are referenced in a specific document, the number of the document is provided. For information on how to order Referee Materials, contact the Technical Division, SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001, (412) 776-4841.

SAE Part No.	Description	Reference Document
RM-3a	SBR Brake Cups–Wheel Cylinder	J1702 f
RM-4a	SBR Brake Cups–Primary Master Cylinder	J1702 f
RM-5a	SBR Brake Cups–Secondary Master Cylinder	J1702 f
RM-6a	Corrosion Test Strip–Tinned Iron	J1703 NOV83
RM-7	Corrosion Test Strip–Steel	J1703 NOV83
RM-8	Corrosion Test Strip–Aluminum	J1703 NOV83
RM-9	Corrosion Test Strip–Cast Iron	J1703 NOV83
RM-10	Corrosion Test Strip–Brass	J1703 NOV83
RM-11	Corrosion Test Strip–Copper	J1703 NOV83
RM-12	Wheel Cylinder Piston	J1702 f
RM-13-02	Aluminum Master Cylinder Piston	J1703 NOV83
RM-14b	Wheel Cylinder Assembly	J1702 f
RM-15b	Master Cylinder Assembly	J1702 f
RM-17	Brake Master Cylinder Push Rod Assembly	J1702 f
RM-20	Outlet Tube Connection	—
RM-21	Bolt	—
RM-22	Gasket	—
RM-23	Gasket	—
RM-24	Wheel Cylinder Connector	—
RM-25	Copper Gasket	—
RM-26	Inverted Tube Nut	—
RM-27	Tinfoil (Approximately 6 x 6 Inch Sheet)	J1703 NOV83
RM-28	Hiding Power Test Chart	J1703 NOV83
RM-49	Corrosion Test Jar with RM-63 Lid	J1703 NOV83
RM-51	Effect on Rubber Test Jar	J1703 NOV83
RM-52a	Tinned Lid–Effect on Rubber Test Jar	J1703 NOV83
RM-57	Tubing–¼" O.D.	J1702 f
RM-58	Tubing–3/16" O.D.	J1702 f
RM-59a	Glass Oil Sample Bottle (4 oz.) with cork	J1703 NOV83
RM-60	Storage Corrosion Test Fluid	J1601
RM-61	Screws and Nuts for Corrosion Test	—
RM-62	Screws and Nuts for Resistance to Oxidation Test	—
RM-63	Jar Lids for Humidification Procedures, MVSS116, S6.2	J1703 NOV83
RM-66-03	High Boiling Compatibility Fluid DOT 3 HD 50-4 450° Blend	J1703 NOV83
RM-68	Neoprene Brake Hose Inter Liner Stock (ASTM D15 Test Slab)	J1401 JAN81
RM-69	EPDM Stock (ASTM D15 Test Slab)	J1601
RM-70	Silicone Base Compatibility Fluid	—
RM-71	Triethylene Glycol Monomethyl Ether	J1703 NOV83

ENGINEERING AIDS

SAE is the supplier of drafting templates and machines in its Engineering Aids Program. These drafting templates and machines are referred to in reports prepared by the SAE Human Factors Engineering Committee.

The two-dimensional drafting templates and three-dimensional H-point machine have been certified by SAE for adherence to the SAE standards and for exact repeatability between individual templates and machines.

The reports, templates and machines are as follows:

SAE J826 APR80—DEVICES FOR USE IN DEFINING AND MEASURING VEHICLE SEATING ACCOMMODATION

SAE Part # EA-2—TWO-DIMENSIONAL DRAFTING TEMPLATE—This two-dimensional drafting template is used to aid in displaying data obtained from checks made with the three-dimensional H-point machine. It describes passenger compartment space and seating attitude for comparison and reporting purposes, and describes passenger compartment space and seating attitude during conception, engineering and development stages of any new vehicle. This is a nude male consisting of a 10th, 50th, and 95th percentile measuring 32 x 23 x 2 weighing 7 lbs.

SAE PART # EA-3—THREE DIMENSIONAL H-POINT MACHINE—(Shipped collect from SAE Headquarters, Warrendale, PA.) The three-dimensional H-point machine is used to check vehicle seating compartments for conformance to design specifications; that is, relationship of H-point to body structures, seats, controls, etc. In the absence of design information, the horizontal and vertical H-point location is normally verified graphically using the two-dimensional template, and aids in the design and development of seats and seat materials. SAE also has the H-point machine available for rental purposes. The H-point machine measures 33 x 24 x 37 and weighs 295 lbs.

SAE J94I MAR81—MOTOR VEHICLE DRIVER'S EYE RANGE

SAE PART # EA-4—SIX PLAN AND SIX SIDE VIEW EYELLIPSE TEMPLATES (Set of 12)—The 12 templates represent six specific normal driving and riding seat track travel lengths ranging from a minimum of 4.0 inches to a maximum of 6.5 inches in 0.5 inch increments.

The eyellipse template is a design tool from which sight lines can be constructed. These sight lines are used to describe the location of objects in the field of view of a seated driver.

SAE PART # EA-5—EYELLIPSE AND HEAT CONTOUR LOCATOR LINE–ADJUSTABLE SEAT—A drafting tool that describes the position of the eyellipse and the occupant head contour for horizontally adjustable seats with back angles between 5 and 40 degrees.

SAE J1052—MOTOR VEHICLE DRIVER AND PASSENGER HEAD POSITION (Set of 4)

SAE PART # EA-6—FOUR HEAD POSITION CONTOUR TEMPLATES—Two-dimensional shapes that describe the seated vehicle occupant head positions in side and rear view. The driver head position contours with seat travel apply to drivers in horizontally adjustable seats. The heat position contours without seat travel apply to both drivers and passengers in fixed seats.

SAE PART # EA-7—DRAWINGS FOR OBSCURATION CHECKING FIXTURE (Set of 31)

SAE PART # EA-8—DRAWING FOR HYBRID III DUMMY (Set of 246)

SAE PART # EA-9—MIRROR FACING TWO DIMENSIONAL DRAFTING TEMPLATE

SAE PART # EA-10—DRAWINGS FOR ISO 2575–ROAD VEHICLES SYMBOLS FOR CONTROLS, INDICATORS, AND TELL-TALES (Set of 32)

* * * * *

The templates and machine may be ordered by writing to:

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